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DEPARTMENT OF COMMERCE AND LABOR
BUREAU OF LABOR

CHAS. P. NEILL, Commissioner

LEAD POISONING IN POTTERIES
TILE WORKS, AND PORCELAIN ENAMELED
SANITARY WARE FACTORIES

BULLETIN OF THE UNITED
STATES BUREAU OF LABOR
WHOLE NUMBER 104



INDUSTRIAL ACCIDENTS AND HYGIENE SERIES

No. 1



AUGUST 7, 1912

WASHINGTON
GOVERNMENT PRINTING OFFICE
1912


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LEAD ^{including} POISONING IN POTTERIES, TILE WORKS, AND PORCELAIN ENAMELED SANITARY WARE FACTORIES.

BY ALICE HAMILTON, M. A., M. D.

INTRODUCTION AND SUMMARY.

The four industries included in this study have one important feature in common—that of employing a glaze containing one or more compounds of lead. In other respects they differ more or less widely; in methods of handling the glaze, in workshop conditions, in wages, in the class of workpeople, and in the number of women employed.

The four industries studied fall into two divisions. The first division comprises: (1) The making of so-called white ware, which means sanitary earthenware and table and toilet ware; (2) The making of cheap earthenware bowls and teapots, of decorated bowls, jardinières, pedestals, spittoons, etc., which are usually summarized as art and utility ware; and (3) the making of lead-glazed wall, floor, and roof tiles; these three differ in some respects but have many features in common. The second division comprises the manufacture of porcelain enameled iron sanitary ware, often called hollow ware, and is quite distinct.

The study of these industries has involved an investigation of 68 potteries and factories located in 9 different States and employing in work which exposes them to the risk of lead poisoning over 2,100 men and nearly 400 women. It has included such points as the method of handling the lead glaze, how much the working people are exposed to it, and what precautions are taken to protect them. It has also involved a study of the people employed, their living conditions, their nationality, the character of their work, and the incidence of industrial lead poisoning among them.

The number of establishments visited in each of these industries and the number and sex of employees engaged in processes involving a risk of lead poisoning were as follows:

ESTABLISHMENTS VISITED AND EMPLOYEES IN PROCESSES EXPOSED TO RISK OF LEAD POISONING, BY INDUSTRIES, 1910 AND 1911.

Industry.	Estab-lishments visited.	Male em-ployees.	Female em-ployees.	Total.
White ware pottery.....	40	796	150	946
Yellow ware and art and utility ware pottery.....	7	166	39	205
Tile works.....	11	138	204	342
Total.....	58	1,100	393	1,493
Porcelain enameled iron sanitary ware.....	10	1,012	.....	1,012
Total.....	68	2,112	393	2,505

The principal centers for the making of white ware in the United States are Trenton, N. J., and East Liverpool, Ohio. The manufacture of the yellow ware and Rockingham, included in the second industry, is vanishing, but is still carried on in East Liverpool and in the district of Ohio of which Zanesville is the center. Art and utility ware is made chiefly in the Zanesville district. The 11 tile factories visited are in Trenton, N. J.; Newell, W. Va.; Covington and Newport, Ky.; Indianapolis, Ind.; Chicago, Ill.; and Zanesville, Ohio. Porcelain enameled hollow ware is made chiefly in and around Pittsburgh, Pa.; Chicago, Ill.; Louisville, Ky.; Chattanooga, Tenn.; Sheboygan, Wis.; several small towns in Ohio; and in Trenton, N. J.

CHARACTER OF DANGERS IN THE INDUSTRY.

In the industries of the first group both men and women are employed in the dangerous processes,¹ in the fourth industry men only. In the first three industries the processes which involve a risk of lead poisoning are: (1) Mixing the glaze, done by men; (2) dipping the ware in the glaze or applying the glaze in other ways, done by both men and women, though men predominate; ² (3) handling the ware while the glaze is still wet, done by men, women, and boys; (4) removing excess glaze from dry ware, done by both sexes; (5) decorating the ware with lead colors, done by both sexes; (6) cleaning or sweeping dusty floors, boards, or tables, done by both sexes.

In the fourth industry, the manufacture of porcelain enameled hollow ware, there are only two dangerous processes—mixing and grinding the ingredients for the enamel and applying the enamel. The former is done by mill hands, usually Slavs but sometimes

¹ Throughout this study the words "dangerous" and "risky" are used to indicate only danger or risk of lead poisoning.

² In the making of white ware no women dippers were found, and in the second industry only one, but in the tile potteries they were employed both as hand and as machine dippers. See pp. 22, 25, and 28.

Negroes. The application of the enamel is skilled work, usually done by Americans or Slavs. The cast-iron ware, after first being given a liquid coat, is heated red hot, and before it can cool powdered enamel is sprinkled over it and it is returned to the furnace. After the enamel has melted over the iron, the ware is taken out and another coat is sprinkled on, this process being repeated several times. This is extremely dusty work, the enameler and his assistant being surrounded by clouds of powdered lead glaze, which fills the air and falls over their hair and clothes and over their bared arms and chests.

The degree of danger involved in these various processes depends partly on the amount of lead used in the glazes and partly on the use or neglect of various methods and devices for protecting the workers. In the white-ware potteries visited the glazes used contained from 1.75 to 33.3 per cent of raw white lead. In the potteries making art and utility ware and in the tile factories the glazes contained from 5 to 60 per cent of white lead. In the fourth industry it was difficult to obtain reliable information on this point, but it is known that enamels are in use containing from 2 up to 25 per cent of lead.¹

The precautions which should be taken in establishments using such glazes are indicated by the nature of the danger. Lead is a slowly cumulative poison which enters the human system chiefly through the digestive tract. The mucous membrane of the respiratory tract may absorb some lead salts, and lead has also been found to penetrate the blood vessels of the lungs and so to reach the general circulation. However, the greater part of the lead which is breathed in as dust is swallowed with the saliva, thus reaching the stomach, and this is the most frequent mode of poisoning by lead. Next in importance comes poisoning by lead salts, which are carried into the mouth with food or chewing tobacco which has been handled with lead-covered fingers or left exposed in a room where there was lead dust or carried in the pockets of dusty clothes. Absorption of lead salts through the unbroken skin is probably so little as to be negligible.

It follows, then, that the prevention of lead poisoning in a factory in which lead glazes are used depends upon measures to prevent dust, so that the workman need not breathe in lead, and measures to provide for personal cleanliness, so that he will not convey lead into his mouth from his fingers or carry it home on his body or clothes.

SANITARY CONDITION OF POTTERIES.

Preventive measures of both these kinds were conspicuously absent in the establishments investigated. Generally speaking, no effort was made to keep down the amount of dust and no provision made for carrying it off by exhausts or other mechanical devices. Processes

¹ See pp. 13, 24, 26, 32, and 33.

which involved no dust were carried on in the same rooms with dusty ones, exposing workers in the first to a wholly unnecessary danger. The construction of the floors and the methods of cleaning added to the risk. Hot water, an absolute necessity for removing the lead from the hands before eating, was furnished in but a few instances, and soap and towels not at all. Lunch rooms were not provided, and in many instances workers ate wherever they could find a place, regardless of whether or not lead dust was thick about them. No medical care was given the employees except when one of them was taken violently ill while at work.

EXTENT OF LEAD POISONING AMONG POTTERY WORKERS.

It was impossible to make a thorough census of the cases of lead poisoning which had occurred during the last two years, but those found were unduly numerous if compared with the number of cases known to occur in British establishments of the same kind. Compared with British potteries, American potteries, with less than one-half the work people, show almost twice as many cases of lead poisoning. Of late years there has been an enormous decline in this form of industrial poisoning in England, due to sanitary regulation, while in this country there is an almost entire absence of such regulation. If American wages are higher and living conditions better, these advantages seem to be more than offset by the lack of sanitary control and of proper regulations for the protection of the workers.

Among the 796 men in the white-ware potteries 60 cases of lead poisoning were found to have occurred during the two years 1910 and 1911, 39 of which occurred during the latter year. Among the 150 women there were 43 cases, 29 of them occurring during 1911. A single local of the Dippers' Union, which gave accurate records of 85 men for one year, showed that 13 had acute lead poisoning during that year.

In the potteries making art and utility ware and in the tile factories poisoning was more common. Among the 304 men employed 63 cases of poisoning were found to have occurred in 1910 and 1911, of which 48 occurred in the latter year. Among the 243 women 35 cases were attributed to the two years, 28 of which had occurred in 1911.

It will be noticed that the men employed in the white-ware potteries showed in 1911 one case of poisoning for every 20 to 21 employees, while those employed in the art potteries and tile factories showed in the same year 1 case of poisoning for every 6 or 7 workers. Probably this difference is due in part to the smaller amount of lead in the glazes used and partly also to the fact that the white-ware male potters are very well paid, and therefore well fed and well housed. The art potters and tile workers have the disadvantage of low wages, with all that that implies.

The women in the white-ware potteries suffer more in proportion to their number than do those in art potteries and tile works. This is explained by the fact that all the women in the glaze departments of white-ware potteries are doing dangerous work, while in the tile factories many women are engaged in the comparatively safe work of placing glazed ware in receptacles to be fired. All of these women in white-ware potteries, as well as in tile works and art potteries, earn low wages and are often poorly fed and housed.

Taking all the men and women employed in these three industries, it was found that among the 1,100 men there were 87 cases of lead poisoning in a single year, or 1 for every 12 or 13 employed, and among the 393 women 57 cases, or 1 for every 7 employed.

In the fourth industry, the porcelain enameling of iron hollow ware, 309 cases of lead poisoning were found to have occurred in the 10 factories studied within two years' time. One hundred and eighty-seven cases occurring in 1911 were either reported by physicians, obtained from hospital records, or discovered by personal examination of workers.¹ One hundred and forty-eight enamelers and mill hands were examined, and 54, or 36 per cent, were found to be suffering from chronic lead poisoning.

SYMPTOMS AND PROGRESS OF LEAD POISONING.

When a person is exposed to lead-laden dust or habitually eats his food with lead-soiled hands the poison accumulates in his system and usually attacks first the digestive tract and the blood. He acquires a peculiar pallor, which foremen and workmen soon learn to recognize, and which is caused partly by poverty of the blood, partly by contraction of the surface blood vessels. He begins to lose his appetite, especially for breakfast, for he is apt to get up with a foul mouth and to vomit if he tries to eat solid food. A peculiarly disagreeable, sweetish taste is one of the early symptoms and increases the man's repugnance to food. Then he begins to lose strength and to have headache and pains in his limbs. He is almost always constipated, and this trouble increases till it may culminate in an attack of agonizing colic with complete stoppage of the bowels. This so-called lead colic is what the men themselves and many physicians recognize under the head of acute lead poisoning, although a man is usually poisoned for some time before it comes on and may be severely poisoned without ever having colic.

If the victim of acute lead colic leaves his occupation for a more healthful one he may recover completely from the effects of the lead, though there are authorities who insist that even one attack leaves permanent changes in the blood vessels and in the liver. But if the man goes back to the same work he develops the chronic form of lead poisoning, with perhaps recurrent attacks of colic. Chronic

¹ 30 cases reported by workers are not counted here; see p. 59.

lead poisoning is essentially a disease of the blood vessels, leading to degeneration of the organs, to atrophy of the digestive glands, hardening of the liver and kidneys, derangement of the heart, and premature senility.

With either the acute or the chronic form there may be involvement of the nervous system. If the poison attacks the nerves and spinal cord only, paralysis comes on, most commonly in arms and wrists, sometimes in shoulders and legs, sometimes general. If it attacks the brain, there is headache, dizziness, disturbances of sight, loss of consciousness, or convulsions, which may be fatal, or may end in more or less lasting insanity. Paralysis is more common in men, convulsions in women.

TYPICAL CASES OF LEAD POISONING.

The history of a few typical cases may serve to illustrate this description:

Case 1.—This is a typical case of mild chronic lead poisoning. A girl of 19 years has worked 3 years in the dipping room of a white-ware pottery, during which time she has had two attacks of colic. She is pale and has not much strength, partly, her mother thinks, because she eats so little. She is very apt to vomit in the morning if she takes breakfast, and can eat nothing at any meal till she has had a sour pickle to rid her mouth of the sweet taste. She is always constipated and takes cathartics regularly. She is not allowed to go into the biscuit warehouse to eat her lunch, because the forewoman objects, so she eats in the dipping room after washing her hands in cold water. She comes home with her skirts full of glaze dust, and it is almost impossible to get rid of it.

Case 2.—This is another instance of chronic lead poisoning in a woman. She has worked for 10 years scraping and blowing glaze from the edges of dipped tiles; she has never had colic, but she has grown very nervous and has had repeated attacks of dizziness and loss of consciousness, so that a doctor would have to be summoned and she would be carried home. She was transferred to another department in the tile works, but she did not like it, and left to enter the glaze room of another factory, where she soon had an attack of unconsciousness so alarming that she was discharged and not allowed to return. She is pale, thin, tremulous, and so excessively irritable and excitable that her family treat her as if she were not quite sound mentally. This woman will undoubtedly have cerebral lead poisoning of a serious type if she returns to this work.

Case 3.—This woman had severe cerebral lead poisoning. She was employed for six years dipping and scraping tiles; she was always a nervous girl and grew increasingly so, suffering from bad attacks of dizziness and fainting. One morning she awoke to find both legs paralyzed. After some weeks she recovered and went back to work, but only for a week, for she fainted away, and when she came to, both arms and legs were paralyzed, her memory was impaired, and she was confused and very irritable and at times had hallucinations of sight. She lived on in this condition for seven years, with occasional periods of improvement followed by relapses, and then died.

Case 4.—Mild chronic lead poisoning. He has been a dipper for 10 years in a white-ware pottery; has never had colic but has grown excessively pale.

so that it is very noticeable. He walks slowly and likes to stop and rest every now and then; has no appetite, has lost weight, and has lost his spirits, so that he seems like a tired old man, though he is only a little over 30.

Case 5.—An instance of an unusually susceptible man. He went to the hospital with lead colic, after working as an enameled helper only three days.

Case 6.—A Slav, 37 years old, with a wife and five children to support. He is paying for his house. He used to be so strong that he could run up the hill on which his house stands, after work, and spend all the evening digging in his garden. Now he climbs up like an old man and sinks exhausted in a chair and if he tries to hoe or rake he has to give it up, he is so weary. He worked for two years as helper in a porcelain enameling factory and six years as an enameled. It was four years before he began to get sick, then his digestion failed, his mouth was foul, he could not eat. He has had frequent attacks of colic and his doctor tells him he must leave the work, but he can not support his family and pay for his house on laborer's wages even if he could find the work. Lately they have put him on a double furnace and he has to work half again as hard and he does not know how long he can hold out. He has no appetite and can not digest his food, he is pale and emaciated, with anxious eyes. He used to be gentle and even tempered, but now he "gets mad at anything," which makes him ashamed but he does not seem able to help it.

Case 7.—A white-haired old man, apparently over 70 years old, weak and trembling, unable to dress himself, tottering when he walks. He is confused and bewildered, and can not find the right word when he tries to talk. Actually he is only 46 years old. For 26 years he has worked in the colored dipping room of a tile factory. It is more than 10 years since he began to feel the effects of the glaze seriously. It took the form of general hardening of the blood vessels, and a few weeks ago he had a stroke of apoplexy with partial paralysis and aphasia. His physician does not believe that he will ever work again.

Case 8.—A Croatian who has enameled sinks and bathtubs for about 10 years. Two years ago he began to lose strength in his arms, especially the right arm. He stopped work awhile and improved, then he went back and grew much worse; his arms were almost completely paralyzed, and he had to be dressed and fed like a baby. After six months he regained the use of his left hand, but his right arm is strongly bent and he can not straighten it. He is deep in debt and is trying for a job as yard laborer in the factory where he used to enamel, but with only one arm he has not much hope of being employed.

Case 9.—Involvement of the central nervous system. This man is a strong young Slav who worked for five months pouring glaze over roof tiles. Then he began to feel sick, had a bad taste and nausea, could not eat, felt weak and "no good." This lasted eight weeks. Then one day, just as he had reached home after work, an attack of colic came on, so violent that he lost consciousness. He was in maniacal delirium for 48 hours, apparently in great pain much of the time. This passed over, and after a period of mental confusion and impaired vision, lasting about two weeks, he regained his normal state. When he was seen three months later he was pale and had not yet recovered his strength.

Case 10.—A young American who had worked two years as an enameled. He had several mild attacks of lead colic and then one so severe that the doctors were unable to control the pain; he became delirious, and during an unguarded moment he took a fatal dose of the morphine which had been left beside him, and died.

GLAZING AND DECORATING OF WHITE WARE, ART AND UTILITY WARE, AND TILES.

GLAZING AND DECORATING OF POTTERY IN GENERAL.

The occupations which expose the worker to the danger of lead poisoning—mixing the glaze, applying it to the ware, removing the excess of glaze from the foot of the ware, handling the ware while the glaze is still wet, decorating the fired ware by tinting, ground laying, or hand painting, and, finally, sweeping the rooms in which the glaze has been handled—are not carried on in exactly the same way in all potteries. Different ware requires different handling, and there are also local peculiarities which demand different distribution of certain tasks, so that the same class of workers are subjected to different conditions in different places.

The following description applies to the making of general white ware; that is, table and toilet ware and sanitary earthenware. It also applies in general to the making of yellow ware and Rockingham, of so-called art and utility pottery, and the making of glazed tiles. Special processes used in the art potteries and in tile works which differ from those in white-ware potteries will be described separately.

COMPOSITION OF GLAZES.

Since glazes are used in making pottery of every kind, and since the danger of all the processes referred to depends largely upon the amount of lead in the glaze used, it seems desirable to consider the composition of glazes before describing the processes in which the workers handle them or are exposed to glaze dusts.

The glaze used in general-ware potteries in this country for table and toilet ware always contains lead, no ware of this kind being made in the United States with leadless glaze. Sanitary earthenware is made partly with a lead glaze, partly with a leadless glaze. The smaller sanitary ware, such as basins, lavatories, closets, sinks, etc., is, like most earthenware, first fired, then dipped in a lead glaze and fired again. The larger ware—bathtubs, laundry tubs, sitz baths, urinals, etc.—is fired only once. The glaze is painted on the raw clay, and then the ware is subjected to a single prolonged firing, which biscuits the clay and fuses the glaze. Owing to the long firing at a great heat, lead is not needed in this glaze and only a small percentage, if any, is added. The glaze used for cheap earthenware, known as yellow ware and Rockingham, is very rich in lead; so is that used in decorated ware known as art pottery and also the glaze used on colored wall and floor tiles and, in some instances, on colored roof tiles. The glaze used on white tiles often contains small quantities only of lead.

There has been much discussion in England and in European countries over "fritted lead glazes"; that is, glazes made by adding the lead to the glaze-forming constituents and fusing them together, in the course of which fusion the lead is, at least in part, changed to an insoluble silicate. Such glazes are looked upon as very much less harmful than raw glazes. This question has not apparently been considered in the United States up to the present time, for lead-fritted glazes are not used in our potteries at all, so far as could be ascertained, except in one tile pottery, where part of the lead is fritted. Our glazes are subjected to a fritting process; but the lead, usually white lead, more rarely red lead, is added after the fritting is over.

The glaze with the smallest percentage of lead is that used for large sanitary ware, when a lead glaze is used at all, for much of it is made without lead. That used for smaller sanitary ware has usually less than the glaze used for table and toilet ware. The largest percentage is used for colored tiles, for Rockingham and yellow ware, and for certain kinds of art pottery and majolica, for this ware is fired at a low heat to prevent alteration of the colors.

Forty white-ware potteries were visited, and in 39 of them statements were obtained from the officials as to the amount of lead in the glaze used. In three of these potteries yellow ware and Rockingham were also manufactured; it will be noticed that the glazes used for them never contained under 20 per cent of lead. The officials of nine of the tile works visited gave similar information concerning their glazes. In four of these tile works two kinds of glaze were used, one for white and one for colored tiles. The following table, based on the information thus obtained, gives the percentage of lead in the various glazes:

NUMBER OF ESTABLISHMENTS USING GLAZE CONTAINING EACH CLASSIFIED AMOUNT OF LEAD.

Classified amount of lead in glaze used.	White ware.		Yellow ware.	Art ware.	Tile works.
	Sanitary ware.	General ware.			
Under 5 per cent.	3				
5 and under 10 per cent.	2	3			1 2
10 and under 15 per cent.	2	3			
15 and under 20 per cent.	2	2 23		3	
20 and under 30 per cent.			3 2		4 4
30 and under 40 per cent.		1		2	2
40 and under 50 per cent.				2	5 1
50 and under 60 per cent.			3 1		5 4
Total.....	9	6 30	3	7	7 13

¹ For white tiles only.

² In some of them the amount was said to be "about 20 per cent." So it may have been a little over.

³ Red and white lead.

⁴ Red lead.

⁵ For colored work only.

⁶ Not including one manufacturer who refused information.

⁷ Four works use 2 different glazes; 2 refused information.

These figures are not exactly comparable with those in the British reports,¹ because they represent the amount of white or red lead originally added to the glaze, while the English figures represent the amount of soluble lead found in the finished glaze.

GLAZING AND DECORATING OF WHITE WARE.

DESCRIPTION OF PROCESSES.

As before mentioned, the term "white ware" includes table ware, toilet ware, and sanitary earthenware. Forty white-ware potteries were visited in Trenton and in the East Liverpool district in Ohio. In these potteries the glaze is mixed by or under the supervision of a skilled man who knows what he is handling; it is ground and sifted by laborers who are often ignorant and unable to speak English.

The dangers in the mixing room come from shoveling, weighing, and carrying the white or red lead that goes into the glaze and from grinding and sifting the glaze. This work is done by men who often do not know one powder from another and may be quite unaware that there is any risk involved. The list of cases of lead poisoning given further on shows that these men are not protected from the dangers of mixing glaze.

The liquid glaze is applied to the ware by dippers who are highly skilled English-speaking men. The dipped ware is finished—that is, rid of any excess of glaze—by dippers' helpers. In the sanitary-ware potteries these are young men who must be strong enough to lift the heavy ware, and who clean it by wiping off the glaze with a wet sponge. In the Trenton general-ware potteries the helpers are usually boys of 14 years and over, more rarely women and young girls. They simply stack the ware on boards and carry it to the kiln room, where it is finished by the kiln men, who rub off the dry glaze on aprons or bands of muslin. In the East Liverpool potteries the helpers are all women and girls, who have to clean the ware, usually with a sponge, but sometimes by rubbing off the glaze after it is dry. They also gather up the dry glazed ware and pile it on boards for the kiln men to carry off. The kiln men in East Liverpool and the sanitary men in Trenton do no finishing; they only place the glazed ware in saggars to be fired.

The dipping or glaze room is dangerous because the floor is dusty from glaze which has been splashed over it, and because glaze dust rises from the dried ware as it is stacked up and put on shelves and as it is taken down and carried away. Dust also rises when small ware is finished by dry rubbing. The glost-kiln room² is

¹ Annual Report of the Chief Inspector of Factories and Workshops for the year 1910, pp. 174, 175.

² A glost kiln is one in which glazed ware is fired, the biscuit kiln being used for the ware before it receives the glaze.

fairly clean in potteries in which wet finishing is done by the dippers' helpers in the glaze room, but there is always some glaze dust rubbed off or blown off while the ware is being placed in the saggars. In the Trenton white-ware potteries there is a great deal of glaze dust in the kiln rooms, because the glost-kiln men finish the dry, glazed ware here.

These processes belong to the glaze department. There is another department in general-ware potteries where lead salts are used—the decorating department. The danger of lead poisoning in this department is much less than was formerly the case, because printing and decalcomania have largely displaced the processes of dry-color dusting, known as ground laying, and of color blowing, known as tinting.

MIXING.

Mixing is usually done by a foreman who is acquainted with the substances he uses and who hands over to a laborer for melting and grinding the ingredients he has mixed. In other places a laborer does the mixing, the ingredients being numbered only, so that he does not know what he is handling, and there is no danger of his betraying the formula. The materials used in making the first stage of the glaze, which is known as the frit, may or may not contain a little white lead, but even if it does, by far the larger part of the white lead is added during the second stage, after the fritting is over. The first stage consists in melting the mixture of borates and silicates, with perhaps some white lead, till it is a fluid mass, which is then run into water, where it scatters and hardens quickly in feathery masses. This, the so-called frit, is then ground to a powder. Whatever lead there is in the mixture is said to have been changed to a comparatively harmless form, lead disilicate, but the invariable custom in all the potteries visited is to add white lead to this frit.

Therefore, when a fritted glaze is spoken of by an American potter, it must be remembered that the one poisonous ingredient, the lead, has been either not at all changed by the fritting, or only in part. The ground frit, to which white lead and other ingredients have been added, is again ground in water mills and is then filtered through silk sieves and, suspended in water, is now ready for use by the dippers.

During the preparation of the glaze the men exposed to lead are the mixer and one or two laborers, who help mix and who convey and dump the mixture. As the grinding is done in water mills, no dust is produced, and the process is not attended with risk. If ordinary care is observed, the work of the mixer and his helper can be rendered safe, and it is in any case only occasional work, done perhaps twice a week, for a large quantity of glaze can be prepared at

one time. If it is carelessly done, the workman may, of course, be exposed to the danger of breathing lead dust. In many potteries the laborer engaged in mixing may be any one of several unskilled men ("odd men" they are called), so that no one man handles the white lead often.

DIPPING.

The dipping of ware is highly skilled work and consists in rapidly immersing the biscuit ware in the liquid glaze, turning it, and bringing it out in such a way that the coat of glaze is evenly distributed all over the surface. The glazed ware is placed on a board or tray to dry and later on is carried to the glost kiln for firing. The dipper works with his sleeves rolled up to the shoulders. His arms are covered with the glaze and his clothes are splashed with it. The floor around the dipping tub is covered with splashed and spilt glaze. This dries and is constantly stirred up by the feet of the helpers as they come and go, and several dippers have spoken of this dust as being, in their opinion, one of the most important sources of lead poisoning among dippers. In Trenton there is, except for this, little production of dust in the dipping room, and were the floor of cement or metal and kept slightly damp all dust could be abolished except the small amount that is caused by lifting and carrying away the tray of glazed pottery. As will be seen later, conditions are not so good in the dipping rooms in East Liverpool.

Dipping rooms are necessarily well lighted and are usually fairly clean, except for the floor, which is almost always of rough, worn boards, white with the accumulated glaze of years. These floors are swept after work hours, in East Liverpool by the dippers' helpers, in Trenton usually by laborers, but apparently they are never really cleaned. Dippers always wear overalls, fully protecting their under-clothing, and they leave them behind when they go home. A dipper leaving work in the afternoon is, as far as one can see, quite free from white-lead dust on his clothing and person. However, at the noon hour he is not so scrupulous. If he does not go home for lunch, he may go to a neighboring eating place in his overalls, or he may eat in the yard of the factory. In winter he often takes his lunch in the dipping room. Besides this, his mid-morning lunch, which is still customary in many potteries, is always eaten in the workroom, and some dippers admit that they do not bother to wash their hands thoroughly before eating, being content to rinse them off in a pail of cold water. Other men, however, are scrupulously careful in this respect.

WORK OF DIPPERS' HELPERS.

Working with the dippers are the dippers' helpers, who sponge or clean the ware to get rid of the glaze on the foot, stack the ware on boards or trays, and, in Trenton, carry it to the glost kiln for firing.

Sanitary ware is large and heavy and the dippers' helpers in these potteries must be well-grown boys or men. In general ware potteries, where the pieces are smaller, the helpers are girls, women, or boys.

In Trenton the dippers' helpers are exposed to no more danger than are the dippers, except for what is involved in lifting and carrying the glazed ware to the kilns. Large pieces of sanitary ware are carried one by one on the helper's shoulder or head. The small pieces of general ware are piled up on boards and these boards are carried on the shoulder or head. The boards are white with glaze dust, and as the small ware dries quickly, the dust flies over the helper as he walks, and boys often show deposits of white dust on their hair and faces and in their nostrils.

Conditions in the dipping rooms are distinctly better in Trenton than in East Liverpool. In the former field it is the custom to employ boys as dippers' helpers. These boys carry the dipped ware, general ware, to the glost kiln as soon as a tray is full. Then it is left for the glost-kiln men to do the "smoothing," or "rubbing off," or "finishing," which means removing the excess of glaze from the foot of the ware. In sanitary ware potteries the dippers' helpers do this work, but they use a wet sponge and do the finishing before the ware is dry, so no dust is produced.

In East Liverpool, on the other hand, the glost-kiln men do no finishing at all and this work falls to the dippers' helpers, who in this field are all women or girls. These helpers are known as "takers-off" and "gatherers." The taker-off stands right in front of the dipper, with the drain board, on which the dipped ware is placed, between them. If the dipper is fairly careful, his helper can keep quite clean, but many dippers scatter the glaze badly by shaking the ware as they bring it out, and girls are often splashed with glaze from head to foot. They wear caps to protect their hair, sometimes, but they can not protect their faces. The taker-off sponges the foot of the dipped ware and then places it carefully on boards to dry.

The gatherer piles together the glazed and sponged ware after it is dry and places the piles on boards for the glost-kiln men to carry away. This gatherer has a much dustier task than has the sponger, but as the work is arranged in most dipping rooms all the people in the room are exposed to the dust raised by any one of them.

The smallest ware, the individual butter plates, can not be sponged as the other ware is, because the pieces are so light that each one would have to be held in place or it would be pushed about by the sponge. Therefore these pieces have to be finished dry by the kiln men in Trenton, by the takers-off and gatherers in East Liverpool. The girls wait until a large number of butter plates have accumulated and then rub them, bottom side down, on a piece of rough flannel or

carpet tacked to a board. Sometimes only the gatherer does this, sometimes both girls. Usually the work does not need to be done every day. It is looked upon as dangerous because it is so very dusty.

These girls also clean the boards on which the dipped ware is carried. Usually they do it by sponging, but sometimes a girl pounds the board against the floor or wall to shake the dust off. The cleaning of the glaze room is also the work of these girls, and is dangerous or not according to the care with which it is done. Some dippers are very particular to make the girls wet the floor thoroughly before sweeping and will not allow them to begin till the day's work is over. Others are indifferent and let the girls sweep any time they choose, perhaps during the noon hour, and they admit that the sprinkling of the floor is done perfunctorily. The girls bring their mid-morning lunch to the dipping room and eat it there, though they prefer to go into the biscuit room to eat. They always eat in their dipping clothes, and it is common talk that the girls are careless about washing their hands before lunch, but this is perhaps not to be wondered at inasmuch as it is exceptional to find in any factory provision for washing except with cold water.

The presence of these girl helpers is said by the dippers to be a distinct disadvantage, not only to themselves but to the men working in the room, for they stir up so much glaze dust with their skirts as they pass to and fro over the floor. The mother of one of these girls said that she could always shake glaze dust from her daughter's skirt and petticoat when she came home.

WORK OF GLOST-KILN MEN.

In the sanitary-ware potteries of Trenton, and in the general-ware potteries of East Liverpool, the glost-kiln men simply place the glazed ware in saggars, and therefore the only exposure to lead comes from getting their hands smeared with the glaze. But in the general-ware potteries of Trenton the glost-kiln men must take up each piece and smooth or finish it by rubbing off the excess of glaze from the foot of the ware on a sort of band, or apron, of rough muslin which they wear around the waist for this purpose. This apron soon becomes filled with dust, and the air around the glost kiln where this work is done is always contaminated with lead dust. The men themselves recognize that this is dangerous and that wet finishing is better, but the assigning of this work to the glost-kiln men instead of to the dippers' helpers, who would have to do it if it were done wet, is a thing of long standing in the Trenton district and could not be changed without disturbing the very elaborate piecework system now in force. It is, however, quite within the power of the men to insist on this change if they care to, as was done in August, 1911, by the glost-kiln men of East Liverpool.

Placing the glazed ware in saggers to be fired, and finishing it when finishing is done, is carried on in the space directly beside the kiln or kilns, and therefore the work is often hot, but ventilation is almost always sufficient during the time the men are placing the ware. As no glaze drops on the floor, the question of cleanliness is not so important here as in the dipping room. Glost-kiln men have, if anything, even less adequate washing facilities than dippers. They also usually eat a mid-morning lunch in the room in which they are working, with unwashed hands. They wear overalls and when they quit work they look well washed and free from dust, but this is only superficially apparent. Some of them say that they only rinse their hands at the factory and wait till they get home for a real cleansing.

The hours in these factories are not long and the dippers and kiln men usually leave work by 4 o'clock in the afternoon. They work rapidly, but their speed is very much a matter of their own regulation.

COLOR WORK.

Decoration used to be a dangerous process in the potteries when ground laying and tinting were more generally done, but the change in popular taste, leading to a demand for clearly defined patterns on white ground, has done away with much of this work. There is more decoration done in East Liverpool than in Trenton, owing to the character of the ware. Decalcomania and printing may be ignored in this inquiry, leaving as the only branches to be considered the grinding and sifting of colors, ground laying, tinting, and hand painting. The hand painters use lead colors, but in an oily medium, and apply them with a brush, so they run no risk if they use the most ordinary care. On the other hand, the preparation of colors, tinting, and ground laying are recognized as decidedly dangerous. The preparation of colors is usually done by one skilled man, the foreman, in a separate room. Ground laying is still done occasionally, but was seen only in one place visited. It consists in dusting dry colors on a prepared surface by means of pads of cotton. The color sticks to the prepared part of the ware and is wiped off from the edges with clean cotton.

Tinting has almost taken the place of ground laying now. It was seen in almost every pottery in East Liverpool, and in some of the general-ware potteries in Trenton, but in several of them so little tinting is done that one man can do all the work of three or four plants. In tinting, the colors are applied in a spray, driven through an atomizer by compressed air. This is the process spoken of in British reports as "color blowing." The ware is held under a hood at the back of which is an electric fan, fixed in a flue or a hole in the wall, which communicates with the outside air. If this fan exerts

the proper amount of suction, and if the spray is not driven with too much force through the atomizer, and if the hood is deep enough to allow the ware to be held a little distance from the tinter, the dangers of the work have been minimized as much as possible. These conditions are not always met. In some factories if one stands at one side of the tinter so as to be able to see between him and the hood, a fine spray of color can be seen blowing back over his person. This is especially true if he is tinting the side of a large object, such as a pitcher or basin. Tinters were seen whose aprons were covered with the color they were using. This work is done by both men and women and is regarded by them as rather dangerous, though the employers believe that they have eliminated all possible risks. Our lists contain eight cases of lead poisoning among decorators in two years' time—five women and three men. The English experts call attention to the greater risk run by nearsighted color blowers and ground layers, who must hold their heads close to their work. They advise against allowing nearsighted people to do this sort of work.

Tinting used to be much more common in American potteries and was done without any attempt to protect the men. There is a night watchman in Trenton who has had to take up that occupation because he has a most persistent double wrist palsy. Fifteen years ago he was a tinter, and did his work, without any protective device for carrying off the lead dust, in a room where numbers of other people were employed, some tinting, many doing other work. He can recall the names of five fellow workmen, all dead now, though none was over 40 years old. Two died with acute lead poisoning, the others had the chronic form. Workmen who were not decorators were often poisoned by the dust that flew about the room.

WORKERS IN WHITE-WARE POTTERIES.

There are 46 dippers in the Trenton district and 85 in Salem and the East Liverpool district, which includes Chester and Newell, W. Va. In Trenton the kiln men number 392, but this includes the men employed on both biscuit and glost kilns. It was impossible to ascertain the exact number of men working on glost kilns in Trenton because in many factories kiln men are shifted back and forth between the biscuit and the glost kilns. In East Liverpool, where this custom does not obtain, there are 300 glost-kiln men, and if the same proportion of glost-kiln men to dippers exists in Trenton as in East Liverpool, there should be something over 150 men employed in that department in Trenton at any one time.

These men are, almost without exception, of American, British, or German parentage. Some of them were born in England and learned the trade there. They are well organized and the National Brotherhood of Operative Potters has a voice in determining the conditions

under which work is done in these potteries. These men are intelligent, skilled, well paid, and they have a high standard of living. All of them are familiar with the risks of their work and know that personal cleanliness is of great importance in the avoidance of lead poisoning. To all appearances they are fairly careful to get rid of the lead glaze when they quit work. Some of them are, however, rather reckless in the matter of eating lunch and handling chewing tobacco with glaze on their hands.

Inquiry into the length of employment of the men in these branches showed the following: One hundred and nineteen dippers averaged a little less than 18 years' employment; 50, or 42 per cent, had worked more than 20 years; 200 glost-kiln men averaged $14\frac{1}{2}$ years' employment; ¹ 63, or 31.5 per cent, had worked more than 20 years. Considering that this is a well-paid industry and that most men enter it before the age of 20, the average length of time that they remain in it seems surprisingly short.

The dippers' helpers in sanitary-ware potteries are usually of the same class as the dippers and are learning the dipper's trade. In the potteries making general ware they are boys, less often girls, still more rarely women. They are often from a poorer class than the dippers; some of them come from Slavic and Italian families, with a lower standard of cleanliness and poorer living conditions. These boys and girls are said to be careless about washing away the lead before lunch, which many of them eat on the premises. They are notoriously unsteady and there is a general complaint of the impossibility of keeping these young helpers for any length of time. One employer said that his boys left every two weeks, and some of the dippers said that they did not trouble to learn their helpers' names for they were always coming and going. In conversation with dippers, one learns that many of these boys drop out because they are affected by the lead. They all know what lead poisoning means, and when they begin to feel ill they leave. It is said to be easy for a boy to find other work in Trenton.

The women and girls in the glaze rooms in East Liverpool number about 135. While the men in the trade are well organized, earn good wages, live comfortably, and are sure of employment, the women are unorganized, their living conditions are very inferior, their pay is low, and they have no secure tenure of their position. Many are widows or separated from their husbands and with children to support; others are young girls from the country, especially from West Virginia, who are boarding or doing light housekeeping. They earn \$1.10 per day, and of that they pay from \$3 to \$4 a week for board and lodging; \$3 is the very lowest for which it can be obtained, and

¹ The Report of the New Jersey Bureau of Labor Statistics for 1889 gives the average years of work for 297 kiln men as $14\frac{1}{2}$ years.

this does not include a place to do their laundry, so they have to pay for that too. Physicians say that a country girl who goes into the glaze room very soon loses her color and becomes strikingly anemic, and the only thing that saves these girls from serious forms of lead poisoning is that they understand the danger of the work and usually give it up after one attack. However, there is very little opportunity in East Liverpool for such a girl to work in any place except a pottery, and if she leaves the glaze room it is only to go into one of the other departments, most of which are dusty and unhealthful; so that the advice given by physicians to a girl to change her occupation can only be followed to a limited extent. On the whole, the women and girl helpers do not stay very long in the glaze rooms. Forty-three of them averaged only two and one-half years' employment. Most of the physicians and workmen interviewed said that the employment of girls and women in the glaze rooms was the worst feature of the industry in East Liverpool.

The unskilled laborers employed in those parts of the potteries where lead is handled are the odd men in the mixing room and those who sweep the floor of the glost-kiln room, rarely of the glaze room. These men are usually Slavs or Italians. They do not belong to the Brotherhood of Operative Potters. They are continually being shifted from place to place in the pottery or from one pottery to another. Often they do not know that they are handling stuff that is poisonous, and they are not told to take any particular precaution.

NUMBER AND DISTRIBUTION OF EMPLOYEES.

The following shows the number of persons comprised in this study of the Trenton and East Liverpool fields:

NUMBER OF WORKPEOPLE IN TRENTON AND EAST LIVERPOOL WHITE-WARE POTTERIES, BY OCCUPATION.

Occupation.	Union records.	Estimated.	Total.
Dippers.....	132	.....	132
Dippers' helpers:			
Men and boys.....		75	75
Women and girls.....		135	135
Glost-kiln men.....	464	.....	464
Tinters:			
Men.....		20	20
Women.....		15	15
Odd men.....		105	105
Total.....	596	350	946

GLAZING AND DECORATING OF ART AND UTILITY WARE.

COMPARISON OF CONDITIONS OF WORKERS IN ART AND UTILITY WARE POTTERIES AND IN WHITE-WARE POTTERIES.

It has seemed best to take up under a separate head the making of yellow ware, Rockingham, and the so-called "art and utility

ware," which means earthenware decorated with colored glazes or with colors applied under or over the glaze. These branches of the pottery industry are carried on under conditions quite different in many ways from those described in the section on white ware. In the United States the National Brotherhood of Operative Potters has organized the workers in the white-ware potteries, and these men make good wages and have a voice in controlling the conditions under which their work is done. The making of cheap yellow ware and of the dark-brown ware known as Rockingham is not strictly in this class. In East Liverpool this ware is in some instances made in one department of a white-ware pottery, and as it was impossible to separate the cases of lead poisoning among the makers of this class of ware from the others of East Liverpool, all the pottery workers in this district have been counted together as white-ware workers. The making of Rockingham and yellow ware is a diminishing industry. In former years there was a great deal made in East Liverpool, but now there is not much. Three potteries still make it, employing 3 to 5 dippers and 10 to 12 kiln men, but only 2 of them were operating at the time this inquiry was made. Yellow ware and Rockingham are made from brown clays, and the glaze used is much richer in lead than the glaze for white ware, usually containing 40 to 50 per cent of a mixture of white and red lead. One advantage, however, is that, as this ware is cheap, no sponging or rubbing of the glaze is done, which means that the glaze needs less handling and that girls are not employed in the dipping room.

The Zanesville district, including Crooksville and Roseville, is the center for art and utility ware potteries, and some yellow ware and Rockingham is also made there. The art ware, consisting of vases, bowls, jardinières, pedestals, spittoons, pitchers, etc., is much of it "single-fire" ware, and the glaze contains a great deal of lead. The decoration is sometimes done with colored glaze (*majolica*), or colors are applied under or over the glaze. Included in this section is one factory making white ware, since it makes also art ware and employs the same class of labor and pays the same rate of wages as the others.

GREATER DANGER IN ART AND UTILITY WARE POTTERIES.

There is a very different state of things found in these potteries from that found in East Liverpool and Trenton, both as to the kind of work done and as to the character of the workpeople. Mixing is more dangerous in these potteries because large amounts of colored glazes rich in lead must be prepared. One pottery employs no less than 10 men in the mill room, and uses a glaze containing 50 per cent of white lead.

COMPOSITION OF THE GLAZES.

The following are the proportions of lead in the glazes said to be used in seven art potteries:

PROPORTION OF LEAD IN GLAZES USED IN 7 ART POTTERIES.

Establishments.	Per cent of lead in glaze used.	Establishments.	Per cent of lead in glaze used.
No 1.....	50	No. 5.....	10-20
No. 2.....	33½	No. 6.....	50
No. 3.....	20	No. 7.....	15
No. 4.....	40		

The dippers are not engaged in dipping only. Some must also do the finishing, either sponging the ware or scraping the glaze off after it has partly dried, an operation which is known as "fettling." In one pottery there was an ingenious arrangement for finishing. Each dipping tub had a scrubbing brush fastened to the edge and as the dipper brought his ware up from the glaze he passed it, bottom side down, over the brush, to remove the excess of glaze. Other dippers spend part of their time laying on colors or colored glazes with paint brushes. One woman dipper was seen who dipped the lower part of the ware in the colored glaze. She was said to be "blending," not dipping, technically. There were 34 men dippers and 1 woman in the 7 potteries studied, and there were 2 boys and 6 girls engaged in fettling or sponging.

The decorating department of an art pottery is very important and really spreads over into the dipping department. Ground laying was not seen, but there is a great deal of tinting or color spraying, a description of which has been given in the section on white ware. Thirty-two men tinters and nine women were employed in the 7 factories studied. Seven men and 23 women were engaged in hand painting. The decorating by dipping is done by the dippers. Of the four potteries in which tinting is done, three were in a condition to be inspected; the other was not at the time using this kind of decoration. None of the three had all their hoods provided with proper exhausts, and in two there were no curtains at the sides of the hoods, so that undoubtedly the lead color which was sprayed over the ware escaped into the room and was a danger not only to the tinters, but to the other workers, for the tinting machines are not in a separate room.

Art and utility potteries, even when kept as clean as possible, are more dangerous than white-ware and sanitary potteries, because the glaze is rich in lead and because there is a great deal of tinting done.

NUMBER AND DISTRIBUTION OF EMPLOYEES.

The following are the numbers employed in these seven plants:

NUMBER OF WORKPEOPLE IN YELLOW WARE AND ART AND UTILITY WARE FACTORIES, BY SEX AND OCCUPATION.

Occupation.	Male.	Female.	Total.
Mixers.....	19	.....	19
Dippers.....	34	1	35
Kiln men.....	72	.....	72
Fettlers.....	2	6	8
Hand painters.....	7	23	30
Tinters.....	32	9	41
Total.....	166	39	205

It must be remembered that the lead that enters into the composition of the glaze is not the only lead used, for the colors put on by painting and spraying also contain varying quantities of lead.

Fifteen of the men in the glaze room of these potteries averaged two and one-half years' employment.

GLAZING AND DECORATING OF WALL, FLOOR, ART, AND ROOF TILES.

NUMBER OF PLANTS STUDIED.

The processes used in the glazing and decorating of tiles are more like those found in the potteries just described than in the sanitary and general ware potteries. Here we have, as in the making of art and utility ware, an unorganized trade employing women and young men at a low wage in work which requires the use of glazes rich in lead.

The potteries in which lead-glazed tiles are made and which form the subject of this study are situated in Trenton, N. J., Zanesville, Ohio, Newell, W. Va., Covington and Newport, Ky., Indianapolis, Ind., and Chicago, Ill. Eleven of these were visited, but in one permission was refused to inspect more than a small part of the factory. All make colored tiles and all but four make both white and colored. In two of them the output of white tiles constitutes 90 per cent of the whole.

COMPOSITION OF GLAZES.

What is true of mixing the glaze in art and utility potteries is true of mixing in tile works, most of which require a great variety of glazes and use large amounts of lead, only two establishments reporting the use of a glaze with as little as 5 per cent, all the other glazes containing 20 per cent or more, the amount even running to 60 per cent in 4 establishments. In the 11 establishments making

glazed tiles included in this report the following statements were made as to the amount of white lead entering into the composition of the glazes used:

- No. 1. Information refused by officials; workmen say 10 to 15 per cent in white; more than twice as much in colored.
- No. 2. White, 5 per cent; colored, 40 to 50 per cent.
- No. 3. White, 5 per cent; colored, 30 per cent.
- No. 4. 20 to 60 per cent.
- No. 5. 30 per cent, colored only.
- No. 6. 20 per cent red lead.
- No. 7. 60 per cent, colored only.
- No. 8. 60 per cent, colored only.
- No. 9. Information refused. Colored glaze chiefly.
- No. 10. White, 20 to 30 per cent; colored, 60 per cent. Part of the lead is fritted.
- No. 11. 20 per cent, colored only.

DESCRIPTION OF PROCESSES.

The mixers are always men, and usually only 1 or 2 are employed in each factory. Sixteen mixers were found in the 11 factories.

White tiles are dipped in a glaze less rich in lead than that used for colored tiles. Several methods of dipping are used—hand dipping, pouring, and machine dipping. In hand dipping the tile does not need to be immersed in the glaze, for only one side is glazed, and the dippers' hands do not become smeared, as in pottery dipping. In pouring the glaze on small tiles, a number of them are placed on a sloping surface which drains into the dipping tub when the glaze is poured over them. Larger tiles, such as roof tiles, are held one by one over the dipping tub while the glaze is poured over. One end of the roof tile is left unglazed because the tile above is to lap over it, and the dipper holds the tile by this end, so if he is careful he can keep his hands perfectly clean. The disadvantage of the pouring method is that a great deal of glaze runs over the edges of the tiles and must be scraped or brushed away by hand.

More common than the pouring method for wall tiles is machine dipping, and this is much the safer way, for no handwork is required except to place the tiles on the traveling belt of the dipping machine and take them off after they have passed over the glaze. There is no splashing from such machines and no scraping or brushing off is needed, because the machine applies the glaze with perfect evenness. This machine dipping is the least dangerous work done in the glaze department of a tile works, and if it were carried on in a room separate from the hand dipping and the finishing it would be attended with very little risk to the workpeople. Such a separation of comparatively safe from dangerous processes was not seen in any

factory visited. Even when all the white ware is glazed in a separate room there is still hand dipping and finishing in this same room, as well as the machine work, because the irregularly shaped white tiles, the border and cornice pieces (known to the workmen as "shapes") are always dipped and finished by hand, not by machine.

Finishing is done in two ways. The glaze that runs down over surfaces where it is not needed may be scraped off with an instrument like a palette knife—a process known as "fettling"—or it may be brushed off with a stiff brush. Now, if it is scraped off before it has had time to dry completely, there need not be much dust. There will always be some, because the scraped-off glaze falls on the table or on the floor and dries. The English experts recommend that all scraping of glazed ware be done over a trough of water, while the glaze is still damp, and such precautions would be of immense service in our tile works. As it is, tiles are often kept over night or even over Sunday before they are scraped, and the girl and boy "fettlers," as they are called, scrape and blow away a fine powdery glaze containing sometimes as much as 60 per cent white lead, which settles on their clothes and hair, and can be seen even in their nostrils. They are, of course, not the only ones who suffer from this dust, as all the others working in the same room, no matter how harmless their occupation, must breathe this lead-laden air.

Brushing is not a common way of finishing, fortunately, but it is sometimes done, and apparently it is left to the finisher to decide which method she will use. The work is usually paid for by the piece, and some women said they could work faster with the brush, while the majority preferred a fettle. In one tile works, the worst of all seen, the work of glazing and finishing is carried on in the same room as all the other processes, from pressing to firing. At the end of the day all the workpeople sweep and brush the floor and tables where they are working, and do this without any preliminary sprinkling. The result is vast clouds of dust, which fill the air so that one can hardly see, and from which the people emerge powdered like millers.

Colored tile glazing is done almost entirely by hand, though plain colors may be put on by machine. The hand dipping is usually done by men, the fettling by women and girls, but in some cases the latter also dip. What has been said of the finishing of white tiles applies to the finishing of colored also. In one factory a very dangerous kind of glazing was seen. It was desired to apply a colored glaze to a tile, the body of which was too hard to absorb much liquid, so liquid glaze was first brushed over the surface of the tiles, which lay spread out on a table, and then dry colored glaze was sifted over this moist surface. Of course the powdered glaze, containing 60 per cent white lead, floated in the air and spread through

the room where all the other glaze workers were employed. In two other factories artistic tiles were painted by hand with colored glazes and finished by scraping and brushing by the men who did the painting.

Tiles decorated with mottled color, called onyx tiles, must be treated twice, first with a harder glaze which forms the background, and then with a softer glaze of a contrasting color, which is sprinkled on. In many tile works the second glaze is dabbed on with balls of cotton soaked in the colored glaze. This work may be done by either men or women. The onyx-tile worker gets his hands covered with colored glaze and splashes it over his apron and the table. In some places another method of mottling still obtains. The tiles, covered with the first glaze by pouring, are spread out on a table, a man takes a pailful of the colored glaze, and, scooping it up in his hand, sends it scattering over the table. Such a way of handling lead glaze needs no comment.

Onyx work is carried on in the same rooms with other less dangerous work. In one factory the sprinkling process just described was done in the same room with all the glazing. In another it was done in a general room in which were the kilns, and three 14-year-old boys were working there at the time as kiln drawers' helpers.

Placing the glazed ware in saggars for the kilns is carried on sometimes in a separate room, and is then attended with little risk from dust, but this is the exception, not the rule. Usually the girls and boys who tend the machine and fettle also place, and the work is done in the same room. Sometimes the kiln men do the placing, but this is unusual.

NUMBER AND DISTRIBUTION OF EMPLOYEES.

This is an approximately correct statement of the distribution of workpeople in the glaze departments of the 11 tile works.

NUMBER OF WORKPEOPLE IN TILE WORKS, BY SEX AND OCCUPATION.

Occupation.	Male.	Female.	Total.
Mixers.....	20		20
Hand dippers.....	54	36	90
Machine dippers.....	17	42	59
Fettlers and brushers.....	5	58	63
Placers.....	25	55	80
Onyx tile workers.....	8	12	20
Hand decorating.....	9	1	10
Total.....	138	204	342

Twenty-five men tile workers averaged a little over three years' employment; 31 women averaged a little less than three years.

SANITARY CONDITIONS IN POTTERIES AND TILE WORKS.

WHITE-WARE POTTERIES.

The white-ware potteries of New Jersey, Ohio, West Virginia, and Pennsylvania are subject to no special rules of sanitation, but simply come under the general State laws governing factories and workshops. There is a remarkable uniformity in these establishments so far as the almost complete lack of hygienic regulations is concerned. A few are better than the majority because they are newer and more spacious; others stand out in contrast because they are under the charge of very careful foremen, who will not tolerate dust, but for the most part what is said of one pottery would apply to all. The provisions required by law in England and Germany for the protection of potters against lead poisoning are not found in our country. Washing facilities consist of small sinks with one or two faucets of cold water. Hot water is very rarely provided; soap and towels never. Often the glost-kiln men must go to the dipping room to wash, for they have no sink provided for them. There are no lockers to keep clothes, which must hang anywhere, sometimes on the walls of the dipping room. There is no lunch room and no place provided for the people to store their lunches away from the dust. The girls in the dipping room often go into the biscuit warehouse to eat their lunches, but sometimes this is against the rules and they are obliged to eat in the glaze room. It is needless to say that no medical care is given the employees of any pottery. If there is a physician attached to the plant, he is called on for accident cases only or to give emergency care to a case of violent colic or convulsions occurring on the premises.

The sweeping is a quite unnecessary danger. In the glost-kiln room the kiln men insist that the odd man who does the sweeping shall either wet the floor thoroughly before he sweeps, or wait until they have gone before he begins, but in the mixing room and the dipping room there is often very little care shown. The girl helpers hurry through their sweeping with a perfunctory preliminary sprinkling, and the dipper often contents himself with insisting that they shall wait till he has gone, though some dippers do compel their girls to do the work carefully. The only safe way would be to flush the floors with a hose, but this is never done.

The men wear overalls or old trousers and shirts, which they leave in the pottery when they have finished work. The women and girls usually put on old skirts and waists, but they often keep on their petticoats, and their street clothes may be left hanging in the dipping room. Not half of them protect their hair by wearing caps, and those who act as helpers for careless dippers get glaze splashed on

their faces and hair, while the girls who gather together the glazed pieces almost always show white dust on their hair and in their nostrils.

ART AND UTILITY WARE POTTERIES.

What has been said of the white-ware potteries applies also to those making "art and utility" ware, only the lack of sanitary control is even a more serious evil in these potteries because the glaze contains so much more lead. Unfortunately, in those very potteries where the most dangerous glaze is used, a very low standard of cleanliness is often found. Indeed, the cleanest and most carefully managed pottery of the seven art pottery works visited is the one which uses the smallest amount of lead. In this pottery the dipping room has a cement floor and it is sprinkled before being swept. It is by far the cleanest dipping room that was seen, but in this same pottery the decorating room has a dusty wooden floor, and one of the hoods over a tinting apparatus had so poor an exhaust that clouds of the spray came back into the room. In another of these potteries there is a careful foreman who keeps the dust in the dipping room down to a minimum, but the weighing and mixing of the glaze is done at one end of the dipping room. A third factory is new and clean, but the remaining four, employing some 150 persons in glazing and decorating, are dusty, dangerous places. In two of them there is not even so simple a precaution as wet sweeping. Not one of the seven provides a room for the keeping and eating of lunches, only one provides hot water, none furnish soap and towels, and none have proper lockers for the workpeoples' clothes.

The worst one is described as follows: This is a crowded, ill-ventilated, neglected place with very dusty wooden floors. There are piles of dust in the corners and on the stairways, and the windows and walls are coated with it. Dipping and decorating with colors and colored glazes are done here, there, and everywhere at the ends of passages or in corners of rooms where other work is being carried on. There is no attempt to separate dangerous from safe work. The exhaust in the tinting machine is not strong enough. Lunches are kept and eaten anywhere. There is no provision for street clothes, and cold water only is provided. All the glaze used contains 50 per cent white lead. Thirty-three employees handle glaze or colors. This factory yielded the largest number of cases of lead poisoning.

TILE WORKS.

In tile factories also there is no sanitary control of the glaze rooms, and because of the large amount of "fettling," i. e., scraping or brushing dry glaze, these are perhaps the dustiest of all. A sink with only cold water for washing, and a rule, often unenforced, that water shall be sprinkled on the floors before they are swept, are the only attempts made in most places against the very real dangers from glaze dust.

The street clothes often hang on the walls of the workrooms. Women workers often go home in the skirts they have worn all day, covered with a long coat to hide the white dust. Caps to protect the women's hair are an exception. Lunches are tucked away in any convenient place and eaten wherever it is comfortable. In one of the best of these plants 15 girls were found eating their lunch at the dipping tables for onyx tiles. Hot water, soap, and towels are never provided. The sweeping must be done by the men and girls after work is over. The floors are rarely if ever washed really clean, and most of them are white with the accumulated dust of years.

A reference to the section in the appendix on sanitary regulations in the British potteries would suggest that there is much more lead poisoning in this trade in our country than over there, for all the provisions for the prevention of lead poisoning which in this country are neglected have been made compulsory in Great Britain. The results of the different policies followed by these two countries can be seen in our records of lead poisoning as compared with British records.

PORCELAIN ENAMELING OF IRON SANITARY WARE.

NUMBER OF PLANTS STUDIED.

The making of porcelain enameled iron sanitary ware, such as bathtubs, sinks, basins, etc., with a lead enamel is a very large industry in the United States. This report does not cover all the factories in which such work is done, but it covers the 5 largest in the country, 2 medium-sized plants, and 3 smaller ones. At the time the inquiry was made there were strikes in two factories, and these places were not open to inspection. These 10 factories are in Chicago, Ill.; Sheboygan, Wis.; Louisville, Ky.; Chattanooga, Tenn.; Salem, Ohio, Allegheny, Monaca, Zelienople, and New Brighton, Pa.; and Trenton, N. J. Altogether they employ between 1,000 and 1,100 men in the preparation and application of lead enamel. These men are the ones who mix the enamel, grind and sift it, the ones who spread it on the ware, and the helpers and foremen.

COMPOSITION OF ENAMEL USED.

The cast-iron bathtubs, sinks, and basins, which have been roughened by sand blasting, are first given a coat called the "slush," or "ground" coat, to fill the pores of the iron, to make the enamel adhere to it and to bring together the expansion coefficient of iron and enamel. This slush contains small quantities only of lead. In several factories the slush was said to be quite free from lead, in others to contain less than 1 per cent. One sample that was analyzed contained one-sixth of 1 per cent. The slush coat is always applied in liquid form.

The enamel used on sanitary ware is a lead glaze consisting of silicates, borates, fluorides, alkalis, usually both soda and potash, introduced, in part, as feldspar, carbonates or nitrates; alkaline earths, calcium, magnesium and barium oxide; and the oxides of tin, zinc, and lead. These are fused to a liquid and run out from the oven into cold water, which causes it to harden into feathery masses known as the "frit." After drying the frit is ground and sifted, and is ready for use. The lead content of this glaze depends partly on the peculiarities of the ware, partly upon the prejudices of the users (many chemists say that more lead is generally used than is really required). On the theory that lead is the element giving elasticity to the enamel, it is customary to add less lead to an enamel which is to cover an even surface, where expansion and contraction will be evenly distributed, and more to an enamel which is used over rims or projections, where there will be unequal expansion requiring greater elasticity. A commercial chemist of many years' experience says that the lead in an enamel for sanitary ware seldom runs below 5 per cent or over 25 per cent, but that he has found enamels in use containing as little as 2.9 per cent.

As a rule, questions about the quantity of lead in the enamel are evaded by the managers of these plants, but four of them gave the following:

No. 1: 6 to 8 per cent litharge in mixture A; no lead in mixture B; 55 to 60 per cent of A added to B. Slush coat one-fourth per cent litharge.

No. 2: 5 per cent red lead.

No. 3: 5 to 8 per cent red lead.

No. 4: 2 per cent red lead.

These statements applied to the enamel in common use in each plant. A recent writer on the subject gives the formula of an enamel which he says is in common use in three factories in the United States.¹ It contains 160 pounds of red lead in melted weight, in 990 pounds melted weight, or 16 per cent. The writer referred to states that a higher per cent than this is probably used in all plants for certain kinds of ware.

It is not so important to know how much lead oxide goes into the mixture as to know what change it undergoes in the fritting process and what soluble, and therefore poisonous, compounds are present in the finished enamel. The statement made by managers and company officials in general is always to the effect that when the ingredients are fused to form a glaze the lead is changed to the disilicate, insoluble in the gastric juice, and therefore not poisonous. According to Prof. A. V. Bleining, of the Bureau of Standards, Department of Commerce and Labor, "this statement is not true. The

¹ Homer F. Staley, *The Control of Fusibility in Enamels*. Reprinted from *Transactions of American Ceramic Society*, Vol. XIII, p. 14.

disilicate (PbO_2SiO_2) can not be formed in enamels for the simple reason that there is not enough silica to go around. In fact, Thorpe's statement holds quite accurately." The question as to what actually happens in this fusion process and what forms of lead exist in the so-called frit has been gone into very thoroughly in the Thorpe-Oliver report to Parliament,¹ which defines fritted glazes as those "in which the whole of the lead has been fritted as a properly compounded lead silicate—that is, fritted directly with the other components of the glaze so as to form a double silicate. * * * Experiment shows, however, that much depends upon the nature and composition of the "fritted" lead. * * * The ordinary silicate, containing about 70 per cent lead oxide, 25 per cent silica, with small quantities of alumina, lime, magnesia, and alkalies, corresponding in fact to a crude monosilicate, and which is generally understood as "fritted" lead, is hardly less soluble in acids than basic lead carbonate [white lead]."

That the fritting process in use in the sanitary ware establishments in the United States does not render the lead insoluble is shown by the following analyses of samples of enamel mixtures made for this report by the Bureau of Chemistry, Department of Agriculture. Nos. 6 and 7 are from the same factory.

PER CENT OF SOLUBLE LEAD IN SEVEN SAMPLES OF ENAMEL MIXTURES.

	Sample No. 1.	Sample No. 2.	Sample No. 3.	Sample No. 4.	Sample No. 5.	Sample No. 6.	Sample No. 7.
Per cent soluble lead (PbO) when exposed to the action of 0.25 per cent hydrochloric acid for 2 hours (Thorpe test).	9.04	2.55	6.31	8.35	20.4	0.51	10.22

MIXING OF THE ENAMEL.

According to our present knowledge of these enamels we may say that in grinding, sifting, and applying the enamel, the workmen are exposed to a dust which contains lead in soluble form, soluble, that is, in the gastric juice, and probably also in the saliva and the mucus of the respiratory tract, and in mixing the ingredients for the enamel the workmen must handle the oxides of lead, which are by many authorities considered as among the most dangerous of lead compounds, and by some as the most dangerous of all because of their lightness and dustiness.

Mixing is always done in rooms quite separate from the enameling. The materials which are used, including the lead oxide, are stored in bins or barrels and handled with shovels. In a well-equipped mixing room these ingredients fall through a chute from the storage room

¹ Report on the Employment of Compounds of Lead in the Manufacture of Pottery, by T. E. Thorpe and Thomas Oliver, p. 10. Home Office, London, 1899.

into covered bins, which stand in a row along the wall and above which, at about the height of a man's head or a foot lower, is placed a projecting hood with an air exhaust over each bin. A rail runs along the floor in front of the bins, and a truck on this rail. The workman shovels material from each bin into the truck, pushing it from one bin to the next and opening and closing the air exhaust as he goes. Such an arrangement was seen in 2 of the 10 factories, but even in these the mixer was not protected from dust, for the exhaust was not strong enough to carry it all off, as could be seen by the deposits on top of the hood and on the wall. This dust may, however, have come from the unprotected chute in the floor, down which the mixture was sent to the fritting room below. In only one case was there a hood over this opening.

In the other factories not even these precautions are taken. In two of them the ingredients of the glaze are simply thrown on the floor and there the men mix them by working them back and forth with hoes and shovels, as dangerous a method as could well be conceived. In three others the ingredients of the enamel are shoveled into closed mixers and the mixture is dumped either into a truck or through a hole in the floor.

The rooms with the fritting furnaces, if they are separate, could be fairly free from dust, but they are usually dusty because of careless handling of the dry mixture which comes from the mixing room and goes into the fritting ovens. Grinding the dry frit is a very dusty process in one of these factories, and the evil is added to by the whirling belts of the machinery, which keeps the dust stirred up all the time. Walls, furnaces, and men were white with enamel in this place, and, in addition to the other sources of dust, one man was shoveling enamel into a truck from a pile on the floor. Even the stairway leading up from this room was white with dust. In two other places conditions would have been fair had it not been for leakage from the mills. One plant had a really clean mill room; the remaining three were dusty because the powder was handled carelessly at the chutes coming down from the mixing room or at the sifters or at the final discharge from the mill. The enamel is usually kept in closed receptacles until it is needed, for no dust must fall on it.

In all these processes there is a great deal of unnecessary dust production. Thus, in the mixing department there is no reason why the lead should be handled as carelessly as it often is. A properly protected chute from the storage bins to the mixing room, a hood with a good draft over the bins in the mixing room, and a closed mixer would lessen the dangers to the men working there. The mill rooms could be made fairly safe if all the precautions observed in any one of the plants were observed in all. This would mean that the material from the mixing room should be dropped into a dust-proof

receptacle containing a truck, which truck could then, after the dust had settled, be wheeled out to the fritting oven. The fritting should be carried on in a separate room, because there is no reason why the man here should be exposed to the dust from other rooms. The covers of the mills and sifters should be dust-proof and should never be left open. In one factory a mill was found open and discharging dust, a quite unnecessary source of danger. The finished enamel should be dropped into trucks with covers and transported in these to the enameling rooms. In a number of factories the helpers simply shovel the enamel into pails or into open trucks. The walls, ceilings, and floors of the mill rooms and mixing rooms should be of such material as to permit flushing with water. There should be no dry sweeping or dusting in any of these rooms. The slushers who are not handling dust should work in a room quite separate from the enameleers.

ENAMELING.

Enameling is usually carried on in large rooms, well built, with brick or cement floors, high ceilings, ventilated both from the sides and from the roof, and two factories have in addition hoods with exhausts over each furnace. It is the exception to find small, ill-ventilated enameling rooms. One factory has most of its work done on the two top floors, with ventilation on four sides. The bathtubs, sinks, basins, etc., which are to be covered with enamel come from the sand-blasting department to the slushers, whose duty it is to paint them over with the "slush" or "ground" coat. If the room in which this is done is separated from the enameling room, as it is in one plant, the work is perfectly harmless, but generally the slushers work at one end of the enameling room or in a room opening directly into it and full of enamel dust. After the ware has had this preliminary coat it is handed over to the enameleer and his helper, who put it into the furnace till it is red-hot. Then it is brought out and placed on a turntable in front of the furnace door. The helper turns the ware at different angles, while the enameleer shakes the powdered glaze over it. He uses for this purpose a small or large dredge, according to the size of the ware. The largest are too heavy to carry and are suspended from the ceiling by a chain. These large dredges and some of the smaller ones are worked by compressed air or by electricity, a rod inside driving back and forth and shaking out the powder, but often the enameleer hastens the dredging by striking the handle of the dredge with a ring placed around it, or with a rod. The men say that they feel the shocks of the driving rod in the dredge, and that this makes the use of the larger dredges, with their strong driving rods, very tiring.

The process of heating and enameling must be repeated several times, the ware being returned to the furnace after each coat and then brought out for another coat. Large ware must remain several

minutes in the furnace, and in this interval the men can go over to the windows to cool off or sit down and rest. Small-ware work is more nearly continuous, and it is a question among the men which is the dustier and more strenuous work. On the one hand, small ware does not take so much enamel nor so much strength to handle, but, on the other hand, there are many more pieces to be done.

In putting on the first coat the enameler can stand at a distance from the ware, at about 4 feet from the small ware and 7 or 8 feet from large ware, but the last coat must be put on with great care, so that no uneven places shall remain, and for this the man must come much closer, as close, indeed, as the heat will allow him to. He often uses a wooden mask with eye pieces and a projecting handle which he places between his teeth, and this makes it possible for him to get closer to the hot ware. His helper is not quite so close to the dredge as he is, but there is not much difference. After the ware is done it is gone over by a specially skilled enameler, who looks for the defective spots, and these men may sometimes be seen dusting enamel by hand over imperfectly covered ware.

DANGERS INVOLVED IN THE WORK.

In the enamel room the one thing that places a limit upon the accumulation of dust is the fear that it may blow down or be shaken down from the ceiling or beams and spoil the hot ware. The one factory that has its enameling room on the upper floor has to get rid of the accumulated enamel every week, because the vibration of the building would shake it down. Other places are not cleaned so often. This work is done by a laborer from the mill or by an enameler's helper: rarely does an enameler take the job. It is excessively dusty work, for the dust is blown down from ceilings and walls by compressed air and swept up from the floor. One manager has the men use a hose to flood the walls, ceiling, and floor, and he insists that there is no reason why this method should not be used everywhere. Another manager, to whom the question was referred, said that water could be used just as well but the men preferred the dry way. The only man interviewed who had ever done this work was a Slavic enameler, and he was fully convinced as to its danger. He had agreed to do the work on Sunday to earn some extra money, but he found that the dust sickened him so that he loathed his food for several days after and he was obliged to stop because he was losing strength.

It is the task of the enamelers and their helpers to scrape up the enamel that falls on the floor from the dredges, because this is clean and can be used again. The best arrangement for catching it is a pit or shallow depression in the floor, lined with zinc, which makes shoveling easy. When this is not provided, a sheet of metal is placed under the ware to catch the powder.

WORKERS IN IRON SANITARY WARE FACTORIES.

MILL HANDS.

Compounding enamel is skilled work and must be done by a trained man, who, if he does not actually handle the materials himself, at least superintends the work. The formula is always a trade secret, jealously guarded, which fact sometimes works to the benefit of the men employed, as, for example, in one plant where the laborers who do the mixing are shifted frequently to outside work and other men taken in their places for fear they might learn to know the composition of the enamel. These laborers are always unskilled men, working at the rate of wage which obtains in that place for unskilled labor. In the South they are Negroes; in the North, Slavs. Some of them know that they are working with poisonous stuff, because they have seen men who were affected by it, but others are quite ignorant of the risks of the work. One American workman was visited during a severe attack of acute lead poisoning. He had been employed for only four weeks in a mill room with a leaking mill. He had not known that the millwork was dangerous, though he had known enamellers to become poisoned. The mill hands may, if they choose, leave the plant at lunch time. They usually wear old clothes or overalls, but some work in their undershirts and wear the same shirts home. They are not a steady class of workmen, but change very often, some, according to their own account, quitting because the work makes them sick. It was hard to get information from them because so few of them understood English. Forty-five who were questioned had worked from 3 weeks to 10 years in the mill rooms, but only 16 more than 1 year; 29 had worked less than 1 year.

ENAMELERS.

The enamellers are skilled workmen, earning very good wages. It was said that with steady work a man might make \$1,000 a year, but slack times, breakdowns, or poor materials bring down his earnings until \$2 or \$2.50 per day throughout the year is considered a very good average. It is always piecework, and the man's earnings depend on the supply of work. In Louisville and Chattanooga the enamellers are all American; in Salem, New Brighton, and Zelienople they are Americans and Slavs; in Sheboygan they are Germans, Russians, and Austrians; in Chicago, Pittsburgh, Monaca, and Trenton they are practically all Slavs, this term including Russians, Poles, Bohemians, Slovaks, and Croatians. Many of the homes of these people were visited, and showed evidences of comfort and a high standard of living. Indeed, it was only in the lodging houses of some recent immigrants that there seemed to be overcrowding and poverty. Those who could speak English and German were found to

be intelligent men, quite able to describe their daily work and its effect on their health. The enamelers are usually grown men, but in two plants the majority looked very young; between 18 and 22 years, apparently.

According to some of the employers and most of the foremen these men are heavy drinkers, but nothing was found in the course of the inquiry to show that there is an unusual degree of intemperance among them. On discussing instances of lead poisoning the men would tell whether such and such a case was a heavy drinker or not, and no attempt was made to gloss over the facts. But the heavy drinkers do not seem to be numerous among the Americans, nor unusually so among the Slavs, according to priests and visitors for charitable associations and Slavic physicians.

It is undoubtedly true that some men begin to drink more heavily when they feel the first symptoms of lead poisoning, because the peculiarly disagreeable, sweetish taste so characteristic of this malady yields to bitter beer more than it does to tea or coffee or milk. This gives the men the idea that the beer "cuts the lead and carries it off," and they sometimes maintain this with entire sincerity and say they advise the new men to drink beer as a preventive. Later on, when appetite is gone and there is a loathing for solid food, the men bring their lunches home untasted, and depend on beer. Several of the men's wives noticed this symptom before their husbands had begun to realize that they were victims of lead poisoning. Here there is, of course, a vicious circle, as was pointed out by Pieraccini,¹ the lead poisoning increasing the man's desire for alcohol and making him more susceptible to its ravages, and the alcohol in turn making him more susceptible to the effect of the lead. These men are skilled workmen and their wages permit them to live well, so that they are unwilling to leave the trade, yet their working life is short. Two hundred and fifty men averaged only six years in the trade.

The work of the enamelers' helpers is practically the same as that of the enamelers so far as danger to health is concerned. These helpers are of two kinds, men who are learning the trade and who eventually become enamelers, and boys and unskilled foreigners or Negroes, who are not steady but come and go all the time. Sometimes they quit because the lead affects their health, sometimes because they can not stand the heat. In two factories the enamelers said that they did not even have time to learn their helpers' names before they were gone. It is rare to see young boys employed as helpers: only one factory had them in any number. Nothing definite can be said as to the home surroundings and mode of life of these

¹ Les névroses professionnelles, Proceedings of the International Congress for Industrial Hygiene, Brussels, 1910.

helpers: If they are young Americans learning the trade they may be well fed and cared for, or they may come from very poor families. If they are Slavs or Negroes they live as is usual for such people when they are earning a low wage. Helpers are paid, according to their own statement, from 75 cents to \$1.50 at first; later on they earn from \$2 to \$2.50. Sometimes they earn a day wage with the addition of a small percentage calculated on the earnings of the enameLER. In other factories the helper does piecework, his rate of pay being 70 per cent of that of the enameLER.

NUMBER AND DISTRIBUTION OF EMPLOYEES.

The following is the force employed in the 10 iron sanitary-ware factories included in this study:

Enamelers	900
Mill hands	112
Total	1,012

SANITARY CONDITIONS IN ENAMELING WORKS.

There is no law except in Illinois which requires in establishments using dry lead enamel any precautions for the care of the men other than those required in a box factory, for instance, or a tailor shop. The men in the mixing rooms, mill rooms, and enameling rooms have no place to hang their street clothes away from the lead dust, and no place to keep or eat their lunch. Several times the wives of these men spoke of finding white dust in their husbands' lunch boxes. The millmen may go out into the yard or go home for lunch, but the enamelers are doing piecework and lose money if they stop work to eat. Moreover, the furnaces are running continuously, and the men are not expected to let them run at a loss to the factory. The managers who were interviewed said that the men were supposed to work steadily during the six or eight hours of their shift, except for the necessary pauses while the ware was heating. Consequently these men either eat no lunch at all—many say that the heat or the enamel destroys their appetite and they do not care for lunch—or they take a bite now and then while the tubs are heating. Frequently during the course of this inspection a man would be seen opening his lunch box and taking out some food, then putting it down anywhere (there is no dust-free place), and going off to his work, coming back in a few minutes for the rest of it. Of course, washing the hands and face before lunch is out of the question here; there is no time for it. In some factories the drinking water stands in open pails in the enameling rooms.

If the reader will turn back to the description of the processes used in enameling iron sanitary ware (pp. 33-36), he will see that this is

above all things a dusty trade and that the enamelers and their helpers are for at least two-thirds of their working time breathing in soluble, poisonous lead compounds. One must, however, visit the factories personally to realize how much of this dust there is. In one of the cleaner enameling rooms the furnaces, which were built out into the room, were covered with a deposit of more than 2 inches of the finer enamel dust, which had been carried up by the drafts of air toward the ceiling, and these 2 inches did not represent a long accumulation, for the stuff is carefully gathered up every two months. In every plant visited walls, ceilings, and windows were white with dust, and in spite of ventilators in the rooms, hoods, and open windows, the air is always cloudy when work is going on. Indeed, the enamel powder, consisting, as it does, of ground glass, is not light, and an upward draft carries off only a small part of it, while side drafts simply blow it to and fro. It would seem that a strong down suction would be the only sort of dust removal at all effective.

The men who handle small ware do not have to make great physical efforts to get their ware in and out of the furnaces, but handling the bathtubs requires all the men's strength, even with the help of the mechanical appliances found now in all factories. The excessive heat is exhausting, especially in summer, and more so to the men who are on large ware than to those on small ware. The men's wives speak of their husbands coming home weak and exhausted on warm days, and soaking wet. In some factories the hours are shortened in summer, and four shifts are employed instead of three in order to spare the men and increase the output, for there is often an increased demand for this kind of ware during the building season, but in other factories the long shift comes during the summer time and the short shift is introduced when work is slack.

The elements of heat and fatigue bid fair to grow worse in this trade rather than better, because of the introduction of double furnaces in place of the single furnaces. These furnaces are kept at a somewhat lower temperature, so that the enamel does not fuse quite so quickly, and one man can tend both, for while he is dredging enamel on one piece of ware the other is heating, and by the time the first is ready to go into the furnace the second is ready to come out. This makes his work practically continuous. There are no intervals here for strolling to the windows for a breath of air or sitting down to rest. Even when the hours are shortened from eight to six the man on the double furnace finds his work more exhausting than it was on the single furnace. It is said that the adoption of these double furnaces will probably be general.

When the men leave work they have not got rid of the lead dust. Shower baths are practically unknown. One manager is planning to install them and exhibited the architect's blue prints of a very good

"comfort house." Another factory takes pride in its shower baths, but the neglected appearance they presented was explained by the men who were interviewed and who said that the baths were badly placed and always out of repair. These were intelligent American workmen, accustomed to bathing at home. All were obliged to carry soap and towels to the factory, which furnished nothing but cold water. So far as soap and towels are concerned this is true of all 10 factories, but in some of them the men can get hot water.

No working clothes or caps are provided. The men usually make a complete change when they leave work, but this is not always true. Some of the foreign workmen are said to wear their shirts home, if not their trousers. In one plant which was visited on a very cold day the helpers, boys between 14 and 16 years of age, were wearing good, new sweaters while working, and there can be no doubt that these same sweaters would be worn in the street and at home.

Even more important than provision for cleanliness is the prevention of dust, for no amount of scrupulous washing will save a man who is obliged to breathe in lead dust. In this respect the 10 factories do differ somewhat, because foremen have different standards, and while some are slovenly, others are naturally lovers of cleanliness. One of the 10 factories was beautifully clean, partly because it was very new. The others were of different degrees of dustiness, and in some dust seemed to be so much a part of the place that no effort at all was made to keep it down. Yet a great deal could be done to control the dust without altering the present method of manufacture.

LEAD POISONING IN POTTERIES.

SOURCES OF INFORMATION.

1912 July 1911

In attempting to find out how many cases of lead poisoning have occurred during a given period of time among the workpeople in these industries, one meets with many difficulties. There was no regular medical examination of employees in any factory and no registration of cases of industrial plumbism at the time of this investigation except in Illinois and Wisconsin, where the law had not been in force long enough to give results of value.¹ The records of the trade-unions are of great assistance, but in this inquiry they helped only in the case of the dippers and kiln men in white-ware potteries; the other trades are all unorganized. There was, therefore, no single trustworthy source of information as to lead poisoning in these occupations, and all that could be done was to interview everyone who had any information on the subject, and then sift the evidence and arrive at an approximate statement of the truth. Strict accuracy is not claimed for the following figures, either as to

¹ These laws were enacted in May and June, 1911. Similar laws were enacted in 1911 in California, Connecticut, Michigan, and New York; in 1912 in New Jersey and Maryland.

the numbers employed or the numbers poisoned, except in the case of the potters belonging to the National Brotherhood of Operative Potters, but it is certain that the figures understate the actual facts.

There were four methods used in collecting the cases of lead poisoning on our lists. The first, which yielded the largest number of cases, was to interview the physicians in the town where the plant was situated. Sometimes the information obtained would be too vague for use. A great many doctors can not give the names of their patients, especially when the latter are Slavs with names unfamiliar and hard to spell. If a physician could make only a general statement, such as "I have seen many cases in the past two years, most of them foreigners," he only strengthened the general impression as to lead poisoning in that plant; he did not add one case to our list. But if he said, "I saw four Slovaks last year suffering from lead colic," and if later on four Slovaks were found who said that they had been to this doctor, these men were entered on the lists of cases accredited to the factory in question, even if the doctor could not remember their names.

In some cases the doctor could remember the house in which the man lived or the fact that he had gone into another kind of work or had left the town, from which information it was possible to make sure that he was not one of the cases already listed. Fortunately there are some physicians who speak the languages of their foreign patients and who can give their names and full particulars about them, but usually it is much easier to get information about the Americans than about the foreigners. For instance, in one small town in which there is a sanitary-ware establishment employing both Americans and Slavs, 10 cases of lead poisoning were reported by the doctors from among the American workmen, and probably these were all the cases that had occurred, because all those who spoke English in the place knew each other. Only one case of a Slavic workman was reported by a doctor and he could not remember the man's name. The other doctors had seen Slavs with lead poisoning, but could not remember any details about them.

In East Liverpool, Trenton, Zanesville, Indianapolis, New Brighton, Chattanooga, Louisville, Covington, and Newport there are few or no foreigners employed and the situation is much easier to handle.

The second source of supply was hospital records, of some value in the larger cities with a foreign population, but of little value in most smaller towns, especially if the workmen are Americans. Usually the hospital patients are Slavs or Italians whose families are in the old country.

The third method of discovering cases was by examining the men. It so happened that at the time this inquiry was made two porcelain-

enameling factories had strikes, one involving only the enamellers, the other the whole force. These men were quite willing to be questioned and examined. and as they had all been working up to the moment of the strike there was an opportunity to discover what proportion of the working force of a factory are victims of industrial lead poisoning. A few other cases were seen personally during visits to the homes of men whose addresses had been furnished by doctors. Thus, for example, in the home of a Polish enameler who had had a very bad attack of lead poisoning his young brother-in-law was found. The latter had been employed for only six months as a helper and said he was not sick, but examination showed that the lead line was already present. He admitted that he had become very constipated and was losing strength, and his sister testified that he could not eat his breakfast, nor did he care much for lunch. A woman tile worker who had had several attacks of lead colic called in her husband, who was working in the glaze room at the time, and he also was found to have the lead line and to be suffering from characteristic gastric and nervous symptoms. Several of the cases on our pottery lists were personally examined, as well as the larger number of enamellers.

The fourth method was to collect information from the men about their own attacks of lead poisoning and about the cases they had known among their fellow workmen. When the man himself could be seen it was often easy to determine whether the sickness he had suffered from was clearly lead poisoning or was dubious. But when the story was at secondhand it had to be taken with caution and efforts made to get corroboration from the doctor who had attended the case. If there was reason for doubt the case was omitted from the list. For instance, a Croatian enameler was seen who gave a history of four attacks of "stomach trouble," with violent pain and obstinate constipation. After each attack he quit work, but went back later on. He was very pale and emaciated and had lost strength, his mouth was badly inflamed, and, as is often true in that condition, no lead line could be detected. The case was certainly very suspicious, but the man was a heavy drinker and his symptoms might have been caused by alcoholism, so he was rejected as not proved.

LEAD POISONING IN WHITE-WARE POTTERIES.

This inquiry includes Trenton, N. J., and the part of Ohio and West Virginia of which East Liverpool is the center. Trenton is a city with many trades besides the potteries, and consequently the people in general are not familiar with what happens in that particular industry, and there are physicians whose practice does not take them among pottery workers at all. The East Liverpool district, however, is practically given up to this one trade and here

everyone knows about the potteries, either from personal experience or from common talk, and every doctor has potters and girl helpers among his patients. For these reasons it was easier to trace cases of lead poisoning in East Liverpool than in Trenton. It was always harder to get information about the women and boy helpers and the unskilled laborers than about the dippers and kiln men, because the latter are a steady, organized body of workmen, whose names and addresses can be obtained from the Brotherhood books, who are in the trade to stay, who know each other, and who, finally, are not afraid to answer questions inside the pottery even when the manager is present. On the other hand, the women and boys and the unskilled laborers are a drifting body of working people, in and out of the trade all the time. They are unorganized, nobody knows just how many there are, nobody knows why they drop out of the glazing room when they do; their addresses, often even their surnames, can not be learned, and they are timid and distrustful of questions asked them inside the pottery.

A great deal of information was obtained from union officials, who cooperated heartily in the investigation, and it is believed that the information gathered about the dippers and glost-kiln men is fairly complete. For the cases among the women and girl and boy helpers and the laborers, inquiry was made of 53 physicians—13 in Trenton, 6 in Salem, and 34 in East Liverpool—and visits were paid to the homes of the people whenever it was possible to secure an address.

Most of the 34 physicians in East Liverpool who were interviewed said that there was still a great deal of lead poisoning among the pottery workers in this region, but that there used to be far more than now, and that the cases now seen were seldom of a serious character.

In Trenton only one of the 13 physicians who were visited—a man whose practice was in a large pottery district—said that he still saw many cases of lead poisoning. The others all said that they had noticed a decided dropping off of this sort of practice in recent years, and six had seen no cases at all during the last three years. They attributed this improvement to the smaller amount of lead used in the glaze at present (the impression as to this is general, but we have no proof that it is true), the gradual abandonment of dangerous kinds of decorating, the increasing improvement in the standard of living on the part of the workmen, and their increasing sobriety.

LEAD POISONING AMONG MALE EMPLOYEES IN WHITE-WARE POTTERIES.

To take the men workers first, 60 cases of poisoning were found occurring in two years' time among 796 men. Some of these had left the trade at the time this study was made, and if only those

actually working at the time are counted, there are 49 cases out of 796 employed, or 1 for every 16 to 17 employed. These 60 cases fall under the following heads:

NUMBER OF CASES OF LEAD POISONING IN TWO YEARS AMONG WORKMEN
IN WHITE-WARE POTTERIES, BY OCCUPATIONS.

Occupation.	Cases of lead poisoning.	Number of male employees.
Dippers.....	25	132
Kiln men.....	19	464
Decorators.....	3	20
Helpers and "odd men" ¹	13	180
Total.....	60	796

¹ This term includes the men who help mix the glaze, grind and transport it, and who sweep the kiln rooms and mill rooms.

The dippers evidently suffer more than any other class of workmen. Of 34 dippers who were personally interviewed in Trenton, 10 said that they had had lead poisoning, while only 6 glost-kiln men out of 105 admitted having been poisoned. In East Liverpool, through the courtesy of the secretary-treasurer of the local dippers' union, it was possible to examine the sickness records of 85 dippers from April, 1910, to April, 1911. These dippers averaged 19½ years in the trade and their average age was 40 years. During the year in question 13 of them had had 16 attacks of lead poisoning, 3 had 2 attacks each of colic. This is an unexpectedly large proportion. In the report of the British factory inspection department for 1910-11,¹ the incidence of lead poisoning among dippers is given as 13 cases out of 786 men employed, exactly the same number as in East Liverpool among 85 men employed. In other words, in England 1 dipper out of every 60 suffered from lead poisoning in one year's time, in Ohio 1 out of every 6 or 7.

The number of odd men on the list of cases of lead poisoning is probably below the truth, because of the great difficulty in finding out anything about these men. Included among the odd men are 7 men with lead poisoning who were said to have been employed in the potteries, but whose occupation was not given and who were known to be neither dippers nor kiln men.

There were many more cases of lead poisoning found in East Liverpool in proportion to the men employed than in Trenton. In Trenton about 314 men were employed in work exposing them to lead, and 18 cases of lead poisoning during 1910 and 1911 were found, or 1 for every 17 or 18 employed. Five had been obliged to give up

¹ Annual Report of the Chief Inspector of Factories and Workshops for the year 1910, p. 174.

work because of sickness and 3 had died, lead poisoning being given as either the primary or a contributory cause of death. Only 10 of the 314 then working had suffered from acute or chronic symptoms of lead poisoning during the past 2 years, which would make 1 in 31 to 32 of the force employed at that time.

In East Liverpool, where about 480 men are employed in work exposing them to lead, 42 cases during 1910 and 1911 were discovered, or 1 for every 11 to 12 employed. There were 31 of these working at the time of the investigation—1 for every 15 to 16 employed.

There are several reasons for this difference between the two districts. One has already been mentioned—the greater difficulty in tracing the cases in Trenton. Another is to be found in the fact that the varied industries of Trenton make it possible for a man who begins to feel the effects of the lead to go into some other employment, while in East Liverpool this is much more difficult. Another reason is the fact that more decorating is done in East Liverpool, but the principal cause for the relatively small amount of lead poisoning found in Trenton lies probably in the fact that large quantities of sanitary ware are made there and none at all in East Liverpool. Now, the sanitary-ware potteries are much the least dangerous; first, because the glaze is usually poorer in lead than in the general ware potteries, and, second, because there is less dust. The large pieces are sponged to get rid of the excess glaze and are carried one by one to the kilns. There is no dry rubbing and no dusty gathering and piling together of ware, and no women's skirts stirring up dust, for the employees are all grown men.

The effect of the amount of lead in glaze on the incidence of lead poisoning can be seen in some statistics gathered in Trenton, which give the number of cases of lead poisoning contracted during 1910 and 1911 in handling glazes containing different amounts of lead:

CASES OF LEAD POISONING AMONG WORKMEN IN TRENTON WHITE-WARE FACTORIES USING GLAZE CONTAINING EACH CLASSIFIED AMOUNT OF LEAD.

Per cent of lead in glaze used.	Number of factories.	Male employees.		Cases of lead poisoning.		
		Number.	Per cent.	Number.	Per cent.	Rate per 1 000.
Under 16 per cent.....	11	188	60	5	31	26.6
16 per cent and over.....	7	126	40	11	69	87.3
Total.....	18	314	100	16	100	51.0

Two of the 18 Trenton cases could not be placed. The 42 cases in East Liverpool all came from potteries using from 12 per cent to 20 per cent lead in the glaze.

LEAD POISONING AMONG FEMALE EMPLOYEES IN WHITE-WARE POTTERIES.

The number of cases of lead poisoning found among the women was relatively larger than among the men, and this in spite of the fact that it was very much harder to trace them. It seems certain that although the figures for men potters are fairly correct, those for the women must fall below the truth.

There are about 135 women employed in the East Liverpool district, including Salem, as dippers' helpers in the glaze room and as tinters, and 15 in Trenton, making 150¹ in all. Forty-three cases of lead poisoning were found to have occurred in the last two years. Twenty-five of these women were still working. If it had been possible to interview personally every woman found at work, it is probable that the number of cases discovered would be still larger. To question the girls while they were at work without frightening them into a denial was no easy matter, and it was still less easy to find out where they lived so as to interview them privately. Interviews were secured, however, with 41, and it was found that 14—a little over one-third—had had lead poisoning withing the last two years. If that represents the usual proportion, there would be 51 cases among those now working instead of 25.

RELATIVE NUMBER OF CASES AMONG MEN AND WOMEN.

The contrast between the men and women in East Liverpool in respect to the incidence of lead poisoning can be seen in the following table:

RATIO OF LEAD-POISONING CASES OF EACH SEX IN WHITE-WARE POTTERIES TO NUMBER EMPLOYED, EAST LIVERPOOL.

Sex.	Employees.	Cases of lead poisoning, still at work.	Ratio of cases to employees of each sex.
Males	480	31	1 to 15 or 16
Females	135	25	1 to 5 or 6

But in order to make a fair comparison between the two sexes it should be limited to the men and women who are employed in the glaze room only, for here both do the same kind of work and are equally exposed to the action of lead. This comparison may be made by taking the women who were personally interviewed and the record of the dippers' union, which was quoted above.

¹ This figure is estimated by counting a little more than 3 women to every 2 dippers in East Liverpool, adding the number found in the few potteries visited in Trenton where women helpers are employed, and the number of women tinters in both cities as far as this could be discovered by inquiry.

RATIO OF LEAD-POISONING CASES AMONG DIPPERS AND DIPPERS' HELPERS
IN WHITE-WARE POTTERIES TO NUMBER EMPLOYED, EAST LIVERPOOL.

Occupation and sex.	Employees.	Cases of lead poisoning, still at work.	Ratio of cases to employees of each sex.
Dippers, male.....	85	13	1 to 6 or 7
Dippers' helpers, female.....	41	14	1 to 3

The contrast between the men and women becomes still greater when one takes into consideration the fact that the average period of employment for the men dippers was $19\frac{1}{2}$ years and for the women helpers only $2\frac{1}{2}$ years.

Though these figures, so far as the women are concerned, are not based on complete evidence, yet they are probably not far from the truth; at least the relative susceptibility of the two sexes is the same as that shown in the Report for 1910 of the Chief Inspectors of Factories and Workshops in Great Britain. This question as to the over-susceptibility of woman to lead poisoning will be taken up later on.

LEAD POISONING IN ART AND UTILITY WARE POTTERIES AND IN TILE WORKS.

CHARACTER OF WORKERS AND WAGES IN RELATION TO LEAD POISONING.

It can not be doubted that the low wage paid in the Zanesville district, which is the center for this kind of ware, is a factor in the causation of lead poisoning among the potters. According to physicians, workpeople, and some townspeople, the wages run from 85 cents a day to \$1.65. Company officials and some other townspeople say that dippers and decorators earn as much as \$2 or \$2.50 a day, but none of the workmen who were interviewed were earning more than \$1.65, and one experienced male dipper had recently been offered only \$1.35 per day. The homes visited were in strong contrast to those of the dippers and kiln men in Trenton and East Liverpool. A further proof of the comparative poverty of the Zanesville potters can be seen in the fact that many married women are working in the potteries with their husbands, a thing that was not once encountered in the towns where the trade is organized.

The people employed in these potteries are all Americans, but they are working for a low wage and the appearance of the men who do the dipping and kiln work is different from that of the men seen in these occupations in East Liverpool and Trenton. They are much younger, some of them mere lads, and they do not stay so long in the trade. Fifteen who were interviewed averaged only six years of employment. Yet in Zanesville there is practically no factory work for Americans outside the potteries and tile works. The women and girls are in the same class as those in East Liverpool, and the same

description would apply to them, but the wage paid in Zanesville is somewhat lower than that paid in East Liverpool.

Several physicians in the Zanesville district spoke in the strongest terms of the evils of low wages in the potteries, and attributed the unhealthfulness of the trade largely to the poverty of the workpeople. This will be gone into more fully under the next section.

The workpeople employed in the tile factories are almost all Americans, except in two plants, one of which employs Slavic men altogether, the other is beginning to employ Bulgarians and Servians. In Trenton the glaze work is almost entirely in the hands of girls, and these girls apparently come from the same class as do the men potters at Trenton. They are not organized but they are well paid, for there is much demand for girl workers in Trenton. It is evident from visits paid to their homes that they are well fed and have a high standard of personal cleanliness. They are intelligent and know that their work exposes them to lead poisoning. They say that they carry soap and towels with them to the potteries so that they can get their hands clean, that they take cathartics regularly to keep off the effects of the lead, and that those girls who feel ill from the effects of the work usually leave, since it is not hard for them to find other work in Trenton.

GENERAL BELIEF AS TO FREQUENCY OF LEAD POISONING.

Probably these facts explain the freedom from lead poisoning in the Trenton tile works, a freedom which was not found anywhere else. In every other city inquiries about lead poisoning in this work met with abundant information from the workpeople themselves and from physicians, but in Trenton, although vague reports concerning girl tile workers with lead poisoning were given by a few doctors, only one individual case was recorded positively as having occurred during the last two years, though every effort was made to find such cases. Yet there are 50 women employed in the three plants in this city. Six girls were interviewed in their own homes, where they would have no reason to be timid in answering questions, but though they had worked in one or more of these places from three to five years, they knew of no cases as recent as the last two years. Two male cases were found, both of them mixers. One had had an acute attack and had quit work; the other was an old mixer with chronic lead poisoning.

Outside of Trenton there is a great deal of lead poisoning in the tile works. There is no organization among these workpeople, either men or women, and many of the men in all the factories except the one which employs Slavs are young, sometimes under 18 years of age. Many married women are employed here, and many girls. They do

not stay long in the trade, even though it is hard in some towns to find other work. Twenty-five men averaged a little over three years' employment; 31 girls averaged 2.9 years. Wages are very low, running, it is said, from 85 cents a day up to \$1.65. One dipper has worked for 28 years in the glaze department of a tile works, and his wages have never been above the latter sum. The homes of the tile workers that were visited were poor, and often the women were working after marriage because the husband's wages were not enough to support the family. In one house it was found that two young married couples were working in a tile factory, while the mother of the two men kept house and took care of the child of one couple. The mother of this child said that she had given up work several times, but had always been obliged to go back because the family could "make both ends meet" only under the most favorable circumstances, and even a slight illness was enough to throw her into debt and force her to return to the works.

Many physicians spoke in strong terms of the evils of low wages in the tile works and art potteries, and attributed the sickness among the pottery workers largely to poverty. One of them said: "There is absolutely no care taken in the tile works or potteries. Lead poisoning is very common in Zanesville, though the severer forms are not often seen. The only thing that keeps the situation from becoming really terrible is that the men can shift to other departments in the pottery and the girls are apt to marry. The poverty is very great, the workpeople are underfed and underclothed." Another Zanesville physician said that there was a great deal of lead poisoning, not only the pronounced forms but the obscurer forms, anemia, chlorosis, nervous troubles, and digestive disturbances. He thought that he saw almost 100 men and girls in the course of a year affected by work in lead. Many girls and boys employed in the tile works are still in their teens and especially liable to the poison. Still a third physician said, "I see more men with characteristic symptoms than girls, but often I see a dozen girls of a Saturday afternoon complaining of anemia and constipation, which I attribute to mild chronic plumbism. Some of them also have amenorrhea, undoubtedly due to lead anemia. The fact that the workpeople shift all the time to other jobs in the tile works explains why there are not more severe cases. Wages are very low. Girls get from \$4 to \$6 per week, and pay from \$2.50 to \$3 for board. This is the worst feature of the trade."

In all, 21 doctors were interviewed in or near Zanesville. Sixteen were emphatic as to the evils of this sort of work and the prevalence of lead poisoning, 3 were dubious, and 2 were quite positive that it was a thing of the past and that the tile works were now all that they should be.

The following is the substance of a characteristic interview with a woman who worked in the glaze department of a Zanesville tile works: She worked for three months brushing; that is, removing the excess of glaze from the tile after it was dried, with a brush. After three months she had an attack of lead colic and had to quit work. She went back and worked for two years more but could not stand it and is now in the pressroom. She earned 85 cents a day. The room is terribly dusty and there is no way of heating it, except when a kiln is drawn; then the heat is driven through pipes under the floor. Between kiln drawings in winter they suffer a great deal from the cold, and in summer they suffer from heat whenever a kiln is drawn. At the end of the day they always brushed the tables, swept into a pile the glaze dust that had fallen on the floor, and then brushed their clothes with the same brush. There was so much dust in the air then that she would almost choke. They had to wear some of their street clothes in winter to work in because it was so cold, and when they got home they could always shake the dust out of their skirts. She wore a cap to keep the dust from her hair, but somehow it always looked dusty. About half the women working there are married. They eat their lunch wherever they can find a warm place, and they wash their hands when they can, but the water is icy cold in winter. Her husband works in the same place. He had pneumonia last fall, and they are still in debt for that. This woman gave the names of one man and three girls working there who recently suffered from lead colic. Her brother-in-law is a placer in this factory and works in the glaze room. He has been there 18 months. He now suffers from indigestion, he can not eat his breakfast, has a bad taste in his mouth in the morning, has lost weight and strength, and has fits of trembling in his limbs so that he feels "like he must nail himself together or he will fall apart." This man has the lead line on his gums. His wife also works in the tile factory; she has to because his pay is so low.

Zanesville is used to illustrate conditions because there is more of this work done there than in any other one town, but what has been said of it applies to all other places studied except Trenton, where conditions are markedly better. Two factories, one in Newport, Ky., and one in Chicago Heights, employ no women.

NUMBER OF CASES OF LEAD POISONING FOUND.

It has not been possible to separate the cases of lead poisoning contracted in the tile works from those contracted in the art and utility potteries. Zanesville, which is the center for the latter industry, has also three tile factories, and the physicians who see cases of lead poisoning know that their patients are working in glaze rooms, but often do not know what establishment they come from. The following list of cases, therefore, includes those found in the 11

tile factories studied and in the 7 art and utility ware potteries of the Zanesville district.

In the 11 tile works 138 men and 204 women are employed; in the 7 potteries 166 men and 39 women, making 304 men and 243 women in occupations exposing them to lead. The cases of lead poisoning must be given without regard to occupation because it was usually impossible to find out what particular work the individual was engaged in.

NUMBER OF WORKPEOPLE AND OF LEAD POISONING CASES IN 11 TILE FACTORIES AND 7 YELLOW WARE AND ART AND UTILITY WARE POTTERIES, ZANESVILLE DISTRICT, BY SEX.

Sex.	Number employed.	Cases of lead poisoning, 1910 and 1911.	Cases of lead poisoning, 1911.
Males	304	63	48
Females	243	35	28
Total.....	547	98	76

FREQUENCY OF LEAD POISONING IN WHITE-WARE POTTERIES AND IN ART AND UTILITY WARE POTTERIES AND TILE WORKS.

If the number of men poisoned in 1910-11 in these two classes of potteries are compared with the number of men poisoned in the white-ware potteries, the influence which the large percentage of lead in the glaze and the poverty of the workmen have on the incidence of industrial lead poisoning becomes apparent. The women are omitted from the comparison because the white-ware women workers are no better off than those employed in art and utility potteries and tile works, with the exception of the difference in the glaze, but the men in white ware are markedly better off than those in the art potteries and tile works. Indeed, the women in white-ware potteries are all exposed to the dangers of dusty work, while many women tile workers are engaged in simply placing the glazed tiles in saggars or in tending different machines.

FREQUENCY OF LEAD POISONING CASES IN WHITE-WARE POTTERIES AND IN YELLOW WARE AND ART AND UTILITY WARE POTTERIES AND TILE WORKS.

Industry.	Men employed.	Cases of lead poisoning in 2 years.	Ratio of cases of lead poisoning to number of employees.
White ware.....	796	60	1 to 13
Yellow ware and art and utility ware and tile works.....	304	63	1 to 4 or 5

This table shows that the work in the last class of industries is almost three times as dangerous as in the first. It must be remembered that the discovery of cases of lead poisoning in these unorganized

industries was much more difficult than in the organized potteries of Trenton and East Liverpool, but it must also be remembered that the labor in the unorganized factories is more shifting and a larger number of men were undoubtedly employed during those two years than our figures indicate.

FREQUENCY OF LEAD POISONING IN BRITISH AND IN AMERICAN POTTERIES.

Even the white-ware potteries alone have an amount of lead poisoning far in excess of that reported for all potteries in Great Britain.¹ Occupations here are differently divided and between the two countries workmen can not be compared class by class, but totals may be compared as follows:

FREQUENCY OF LEAD-POISONING CASES IN EACH SEX IN ALL POTTERIES, GREAT BRITAIN, 1910, AND IN WHITE-WARE POTTERIES, UNITED STATES, 1911.

Sex.	All potteries, Great Britain.			White-ware potteries, United States, 1911.		
	Number employed in 1907.	Cases of lead poisoning, 1910.	Ratio of cases of lead poisoning to number of employees.	Number employed.	Cases of lead poisoning.	Ratio of cases of lead poisoning to number of employees.
Males	4,504	40	1 to 113	796	39	1 to 20 or 21
Females	2,361	37	1 to 64	150	29	1 to 5
Total.....	6,865	77	1 to 89	946	68	1 to 14

It is easy to see that the cases of lead poisoning among the men and women in American white-ware potteries number about six times as many as in all the British potteries and that the women here suffer more than twelve times as much as do the English women workers. Comparing individual classes of working people, as can be done in a few instances, the following is found:

FREQUENCY OF LEAD-POISONING CASES IN SELECTED OCCUPATIONS, BY SEX, ALL POTTERIES, GREAT BRITAIN, 1910, AND WHITE-WARE POTTERIES, UNITED STATES, 1911.

Occupation and sex.	All potteries, Great Britain.			White-ware potteries, United States, 1911.		
	Employees in 1907.	Cases of lead poisoning, 1910.	Ratio of cases of lead poisoning to number of employees.	Employees.	Cases of lead poisoning.	Ratio of cases of lead poisoning to number of employees.
Dippers, male.....	786	13	1 to 60 or 61	132	18	1 to 7
Dippers' helpers and cleaners, female	858	21	1 to 41	135	26	1 to 5

¹ Annual Report of the Chief Inspector of Factories and Workshops for the year 1910, p. 174.

The contrast is even greater when all the American pottery workers are included, as, indeed, must be done if a fair comparison is to be made, for the British report covers yellow ware, Rockingham, majolica, tile works, etc.

FREQUENCY OF LEAD-POISONING CASES IN EACH SEX, IN ALL POTTERIES, GREAT BRITAIN, 1910, AND IN POTTERIES VISITED, UNITED STATES, 1911.

Sex.	All potteries, Great Britain.			Potteries visited, United States, 1911.		
	Employees in 1907.	Cases of lead poisoning, 1910.	Ratio of cases of lead poisoning to number of employees.	Employees.	Cases of lead poisoning.	Ratio of cases of lead poisoning to number of employees.
Males	4,504	40	1 to 113	1,100	87	1 to 12 or 13
Females	2,361	37	1 to 64	393	57	1 to 7
Total	6,865	77	1 to 89	1,493	144	1 to 10 or 11

With less than one-quarter of the workpeople, American potteries have almost twice as many cases of lead poisoning. This result was entirely unexpected, for everywhere in the pottery districts in this country one is told that lead poisoning is much less serious than it is in Great Britain, and the reasons given are that living conditions are better here and there is less alcoholism, but chiefly that there is more lead in the British glaze. The people who give this information are themselves Staffordshire men and have learned the trade over there. They are describing a state of things that undoubtedly existed formerly in the Staffordshire potteries but which no longer exists. Of late years, as the British reports show, there has been a great decline in this form of industrial poisoning in Great Britain,¹ while in this country, though there has been some improvement, especially in the making of white ware, it has not been nearly so great.

If American wages are higher, living conditions better, and the workmen more temperate, these advantages seem to be more than offset by the lack of sanitary control over the potteries and the low standard of sanitary conditions. The glaze used in the Staffordshire potteries, in which the cases of lead poisoning reported for 1910 occurred, contained from 11.2 per cent to 33.1 per cent soluble lead.² In American potteries the lead content ran from 5 per cent up to 60 per cent, but the lack of hygienic control in the United States is much more important than the larger amount of lead in the glaze. There is no freedom from lead poisoning even in those American potteries which use the smallest proportion of lead. The enormous difference

¹ See Bulletin of the United States Bureau of Labor, No. 95, p. 44.

² Annual Report of the Chief Inspector of Factories and Workshops for the year 1910, p. 43.

between the number of lead-poisoning cases here and in Great Britain is due not so much to the control exercised over the amount of lead in the glaze as to the strict regulations which there govern the hygiene of the trade.

SEVERITY OF LEAD POISONING IN BRITISH AND IN AMERICAN POTTERIES.

Although the number of cases of lead poisoning is much greater in this country, yet apparently the more serious forms of the disease are not so frequent here as in England. Perhaps this is one reason for the popular belief that lead poisoning is much greater in Staffordshire than in Ohio and New Jersey.

The English expert, Dr. T. M. Legge, classifies¹ cases of industrial lead poisoning under three heads—

Slight: (1) Colic short and uncomplicated; (2) anemia in adolescence, aggravated by employment.

Moderate: (1) A combination of colic and anemia; (2) profound anemia, apparently without complications; (3) slight muscular paresis, i. e., incipient paralysis.

Severe: (1) Encephalopathy; (2) marked paralysis.

He divides as follows 217 male cases and 280 female cases occurring in Great Britain in the five years 1903 to 1907:

NUMBER AND PER CENT IN EACH CLASSIFICATION OF LEAD POISONING CASES IN BRITISH POTTERIES, 1903 TO 1907, BY SEX.

Classification.	Males.		Females.	
	Cases of lead poisoning.	Per cent.	Cases of lead poisoning.	Per cent.
Severe.....	42	19.4	35	12.5
Moderate.....	97	44.7	97	34.6
Slight.....	77	35.5	144	51.4
Not stated.....	1	.5	4	1.4
Total.....	217	.....	280	.....

The death rate in 11 years, 1899–1909, averaged 1.11 for every 1,000 men employed, and 0.85 for every 1,000 women.²

Only a partial classification can be made of the cases among American workers under these heads for lack of accurate information concerning most of them. Among the cases of lead poisoning that occurred in 1911 in the potteries, histories were secured of 86 men

¹ Report of the Departmental Committee Appointed to Inquire into the Dangers Attendant on the Use of Lead in the Manufacture of Earthenware and China, Home Department, 1910, Vol. I, p. 11.

² Idem, Vol. II, p. 39.

and 51 women, which are full enough to permit of dividing them under these heads.

NUMBER AND PER CENT IN EACH CLASSIFICATION OF 137 LEAD POISONING CASES IN THE UNITED STATES, 1911, BY SEX.

Classification.	Males.		Females.	
	Cases of lead poisoning.	Per cent.	Cases of lead poisoning.	Per cent.
Severe.....	7	8.1	6	11.8
Moderate.....	39	45.3	14	27.5
Slight.....	40	46.5	31	60.3
Total.....	86		51	

The percentage of severe cases among the men in this table is not nearly so high as in the British table. The cases among the women are distributed more nearly as among the English women, but it is very probable that many slight cases among women and girls were not reported.

The deaths for 2 years were 3, all men, among 1,500 employed, or 1.5 for each year, which is about the same as the English death rate. There were no fatal cases found among women during these years.

RELATIVE FREQUENCY OF LEAD POISONING IN MEN AND IN WOMEN.

The British authorities insist that there is a true sex susceptibility to lead poisoning, women being more prone to it than men.¹ One physician stated that men are more liable to the chronic, and women to the acute forms, such as colic and encephalopathy.² The cases of encephalopathy found in this investigation among pottery workers confirm this last statement, for 9 out of 14 cases of this severe form of lead poisoning, and all of the three fatal cases, were women. (Some of these 14 cases occurred earlier than 1910.) At first sight it would seem that the figures of this study bear out also the statement that women are more susceptible to lead poisoning than men, for there are 57 cases among 400 women, or 1 to 7, and only 87 among 1,100 men, or 1 to 12 or 13, but a closer analysis shows that there are factors influencing this difference other than the factor of sex.

In East Liverpool and Trenton the relative proportion of male and female cases more than bears out the English theory. Seven hundred and ninety-six men had 39 cases, or 1 to every 20 or 21, and 150 women had 29 cases, or 1 to every 5 or 6 employed (1911). But

¹ Report of the Departmental Committee Appointed to Inquire into the Dangers Attendant on the Use of Lead in the Manufacture of Earthenware and China, Home Department, 1910, Vol. I, p. 12.

² Idem, Vol. III, Q. 1254.

it has been seen that in those districts where white ware is made and the National Brotherhood of Operative Potters holds sway the women have many handicaps as compared with the men besides that of sex idiosyncrasy. They are unorganized, underpaid, poorly housed, poorly fed, subject to the worry and strain of supporting dependents on a low wage, while the men are prosperous and independent. In the unorganized pottery fields, however, in the tile works and art potteries, men and women are in the same economic class, all making low wages, with everything that that implies, and here no such disproportion is found between the two sexes in the matter of lead poisoning. In the establishments that were studied there were in 1911 304 men employed and 48 cases of lead poisoning, or 1 for every 6 to 7 men; 243 women were employed, and there were 28 cases found, or 1 for every 8 or 9. The ratio of cases is actually greater among the men. Of course, these figures are offered very tentatively, realizing that they can in no way be compared with the British, which are based on a medical examination of all men and women employed and on accurate records as to the number of employees during the year. The results obtained in this investigation can only be suggestive; they are given simply because the contrast between the number of male cases in East Liverpool and Trenton and those in unorganized branches of the trade is too great to be accidental and does seem to point to the influence of poverty as a predisposing factor in lead poisoning even greater than sex.

In discussing the relative frequency of lead poisoning among men and women, several physicians in the unorganized pottery towns said that they saw more male cases than female, and one of them explained this fact by the universal habit of tobacco chewing among the men. Most of the men, he said, use scrap tobacco, carrying it in the pocket of their working clothes and handling it with fingers covered with glaze. A great many of them believe that chewing tobacco helps to keep them from getting poisoned. Two other doctors said that while they saw more men with the typical gastric form of lead poisoning, they saw large numbers of women and young girls with less pronounced and characteristic symptoms which they, however, attributed to the lead, such as profound anemia with constipation and sometimes amenorrhea. Now, it is more than probable that many of these cases were not revealed in the course of this study, for the majority of physicians hesitate to speak of lead poisoning if there is no colic. The British statistics, however, include just this class of cases: "Anemia of adolescence aggravated by employment." Certainly it is probable that this is one reason for the discrepancy between the results obtained here as regards female cases and the results obtained there.

No evidence was secured as to the influence of lead on women as an abortifacient. Miscarriages are very common among these women pottery workers, but physicians and the women themselves say that so many are mechanically self-induced that it would be impossible to discover the part played by the lead. The women feel obliged to work after marriage, and they consider it economically impossible to have more than one or two children at the most. They do not, for the most part, know that lead glaze has an abortifacient action.

LEAD POISONING IN THE MAKING OF PORCELAIN ENAMELED IRON SANITARY WARE.

More difficulty was found in tracing cases of lead poisoning in this industry than in the pottery industry proper, because so many of the workmen are non-English-speaking Slavs. A very large number of cases were reported, but when corroborative evidence was sought it was often found that the man had gone back to Austria, or had moved on to one of the other centers of the trade, or that he was timid and suspicious, refusing to answer any questions. Chicago and Pittsburgh offered the greatest difficulty, because all the force employed there is of this character, and the men are scattered all over the foreign colonies. To give an instance of the trouble experienced, there were 96 cases reported in 1 city as having occurred in the last 2 years. Thirty-seven of these could be traced to the physicians near the plant, 11 were on hospital records, 2 were personally examined, but 46 were unverified cases, depending only on the statement of men who had departed or who refused to let themselves be examined.

It has seemed best, therefore, to give a statement as to the source of these cases side by side with the list of cases.

In all of these towns, except one large town with a small factory employing only Slavs, the fact that sanitary-ware enamellers suffer from lead poisoning is notorious, and physicians in the neighborhood of the plant are able to tell of cases of severe colic, of palsy, and even of encephalopathy, for the form of lead poisoning seen among these men is often severe. The statement was repeatedly made by physicians that "one man in every three," "at least one-half of all the men," "all of them who stay any length of time," suffer from lead poisoning.

The following table gives the number of men employed in the glaze departments of the 10 plants which are included in this study, the number of cases occurring in the 2 years covered by the inquiry, 1910 and 1911, the number in a single year, 1911, the proportion of people then working who had recently suffered from lead poisoning, and the sources from which the cases were obtained:

NUMBER OF EMPLOYEES AND OF LEAD-POISONING CASES, AND RATIO OF CASES TO NUMBER EMPLOYED, IN GLAZE DEPARTMENTS OF 10 PORCELAIN ENAMELED IRON SANITARY-WARE PLANTS.

	Number.	Ratio of lead-poisoning cases to number of employees.
EMPLOYEES.		
In mills.....	112	
Enamelers.....	900	
Total.....	1,012	
LEAD-POISONING CASES.		
In 1910 and 1911.....	309	1 to 3.3
In 1911:		
Reported by doctors.....	106	
Reported by hospitals.....	15	
Found by examination.....	63	
Reported by men.....	30	
Total.....	217	1 to 4.7
Cases among force still at work in 1911.....	199	1 to 5.1

The same warning must be given here as in the chapter on lead poisoning in the potteries, namely, that the number of men employed in this work in the course of a year is undoubtedly greater than 1,012 because helpers drop out frequently and enamelers leave work when they are incapacitated or frightened by illness; and, also, that the number of men poisoned is probably larger than 309, for even with the best of efforts discovery of all the cases can not be expected. This is shown in the fact that the number for two years, 1910 and 1911, is not nearly double the number for the single year 1911; yet lead poisoning is probably not on the increase. The large number of cases in 1911 simply means that these were still in the memory of physicians or still at work in the plant, while some of those who had been ill in 1910 had gone away and been forgotten. It is probable that a number double that for 1911, or 434, would be nearer the truth for the two years than 309. The difficulty in tracing these older cases was especially great in Chicago and Pittsburgh, with their large proportion of shifting foreign workpeople with unfamiliar names. In smaller towns, with American workmen, the names of workpeople are fairly well remembered.

INTENSIVE STUDY OF 148 MEN.

If the most rigid standard be applied to the table given above, and only those cases accepted which were obtained from the records of physicians and hospitals, we should still have 121 in a force of 1,012, or one man for every eight or nine employed. It seems impossible, however, that the number should be as low as that, for it has been made evident that all the cases occurring in a given year could not

be brought to light by the methods outlined above. That the number is below the truth, that those physicians come nearer to it who assert that one man in every three is poisoned by the lead, would appear from the results of a physical examination and an examination of the histories of 148 men who at the time this investigation was made happened to be out on strike. These men were not acutely sick and they had all been at work up to a few days before the examination. They were Slavs, many of them powerfully built peasants, and they were employed in two factories, one of which was unusually dusty while the other was said to be fairly clean.

In making the diagnosis of chronic lead poisoning no one symptom can be taken as positively characteristic. The diagnosis must depend upon a combination of symptoms and physical signs, together with the fact that the man's occupation has exposed him to lead. The detection of granular changes in the red blood cells is looked on as a great help in diagnosis by most German authorities, but Oliver, the English authority, does not find this test of value, and Biondi, an Italian authority on blood, says that it helps in the diagnosis when it is present, but that its absence can not be taken as a proof against lead poisoning. Oliver and certain German writers advise the search for lead in the urine; other Germans say that its presence is not constant enough to make this a trustworthy test.

As for the symptoms which constitute a picture of chronic lead poisoning, the following are given by the principal modern authorities: R. v. Jacksch says: "In typical cases, in spite of the variety of the symptoms, diagnosis is always easy. The presence of the lead line in a man working in lead and a history of colic makes it certain."¹ As symptoms he gives various disturbances of digestion, sense of oppression in the stomach, vomiting, loss of appetite, metallic taste in the mouth, anemia.

Oliver describes the symptoms as pallor and sallowness, with metallic taste, especially in the morning, and says: "If the distaste for food is increasing, the individual should retire or be suspended from work, for it is one of the earliest indications of the resistance to lead having become diminished. There may also be complaint of a feeling of sickness and a tendency to vomit. Obstinate constipation and a sense of tiredness out of proportion to the amount of energy expended are also complained of."²

Laureck³ says that if a lead worker whose digestion has been good begins to suffer from chronic loss of appetite, more or less coated tongue, disagreeable sweet taste, foul breath, eructation of gas, and general lassitude, one would seldom go wrong in making the diag-

¹ Nothnagel's *Spezielle Pathologie und Therapie*, Vol. I. 1910, p. 194.

² Bulletin of the United States Bureau of Labor, No. 95, p. 98.

³ Theodor Weyl, *Handbuch der Arbeiterkrankheiten*, Jena, 1908, p. 43.

nosis of lead poisoning, even if the lead line (absent in men who have lost their teeth) and the anemia have not yet appeared. Absolutely certain diagnostic symptoms for lead poisoning do not exist.

Dr. Albert Fleck, a German authority on industrial diseases, says that "if a lead worker complains of weakness, trembling, loss of weight, foul breath, oppressive feeling in the stomach, itching of the eyelids, and spots floating before the eyes, a diagnosis of lead poisoning is probable. The presence of a lead line makes it certain."

If we combine these varying statements we find that a fairly definite picture emerges, but no one feature of the picture is essential. The blue-black line along the margin of the gums is a valuable help in diagnosis, but is not absolutely necessary; the same is true of a history of colic. The fact that the man's occupation is known to expose him to lead poisoning is always regarded as one of the most valuable aids in diagnosis.

In determining whether or not there was evidence of chronic plumbism in the 148 enamelers and millhands a stricter standard was adopted than any of those given above, and no case was included as positive in which the lead line was not present on the gums (for partial exceptions see cases described under (b) and (c) following), because it was impracticable to carry out blood and urine tests which would have helped out the diagnosis of cases with typical symptoms but no lead line.

All of the cases classed as positive presented the following features:

Presence of the blue-black line on the gums.

History of ill health following present occupation.

Pallor of skin and mucous membranes; often extreme sallowness.

Marked loss of appetite, and distaste for breakfast especially.

Increasing loss of strength.

Gastric disturbances of various kinds.

(a) Thirty-five gave this symptom-complex, and in addition other symptoms were complained of by these men, as follows: Obstinate constipation, 16 men; persistent headaches, 13; loss of weight, 11; nausea and vomiting, 10; arthralgia, 5; tremors, 2; dizziness, 1.

(b) Six had an extreme condition of inflammation of the gums, with caries and loss of teeth, and in these cases the lead line showed slightly or not at all. These men had worked a longer period than most, averaging $10\frac{1}{2}$ years employment, while the general average for the 148 was less than 6 years. They suffered from ill health following entrance on this occupation, pallor, loss of appetite, loss of strength, indigestion, gastric pains, constipation. Three of them complained of nausea and vomiting, 2 of persistent headaches, 1 of tremors.

¹Theodor Weyl, *Handbuch der Arbeiterkrankheiten*, Jena, 1908, p. 561.

(c) Thirteen had had a history of colic, severe enough to require medical treatment, and confirmation of their statements was obtained from the physicians who had treated them. They were at the time this examination was made in ill health, suffering from anemia and indigestion. The lead line was apparent in 10, and in 3 the inflammatory condition of the mouth described above.

There seemed to be justification, therefore, for believing that these 54 men were suffering from chronic plumbism.

Thirty-eight men were looked upon as suspicious cases. Fifteen of these had the symptoms described above as characteristic of lead poisoning, but no lead line; urine and blood tests might have proved them to be cases of plumbism, but as these tests could not be made they must be regarded simply as suspicious cases. The other 23 showed a clear lead line, but either made no complaint of ill health or failed to give a picture typical of lead poisoning. and they, too, must be looked upon as suspicious cases only. Such men would probably in England or Germany be closely watched by the examining physician, if not temporarily suspended from work.

Finally, there were 56 who had no lead line and only vague symptoms. The average period of employment for these three classes was about the same, only slightly longer for the positive cases.

To sum up, among 148 men examined, 54, or 36 per cent, showed evidence of chronic plumbism: 56, or 38 per cent, did not show any evidence of plumbism: 38, or 25 per cent, were not free from suspicion, but could not be regarded as clear cases.

LENGTH OF EXPOSURE IN LEAD-POISONING CASES.

Among the 309 cases of lead poisoning were 186 who gave information as to the length of time they had been employed in this trade. The average was 6 years, but 38 had worked less than 1 year.

ONE HUNDRED AND EIGHTY-SIX CASES OF LEAD POISONING IN THE GLAZE DEPARTMENT OF 10 PORCELAIN-ENAMELED IRON SANITARY-WARE PLANTS, BY CLASSIFIED LENGTH OF TIME EMPLOYED IN THE TRADE, 1910 AND 1911.

Length of time employed.	Number.	Length of time employed.	Number.
1 month and under 3 months.....	3	10 years and under 11 years.....	13
3 months and under 6 months.....	19	11 years and under 12 years.....	5
6 months and under 9 months.....	10	12 years and under 13 years.....	7
9 months and under 1 year.....	6	13 years and under 14 years.....	2
Total under 1 year.....	38	14 years and under 15 years.....	2
1 year and under 2 years.....	9	15 years and under 16 years.....	5
2 years and under 3 years.....	11	16 years and under 17 years.....	2
3 years and under 4 years.....	7	17 years and under 18 years.....	2
4 years and under 5 years.....	9	18 years and under 19 years.....	5
5 years and under 6 years.....	15	19 years and under 20 years.....	
6 years and under 7 years.....	12	Total under 20 years.....	180
7 years and under 8 years.....	8	20 years and over.....	6
8 years and under 9 years.....	19	Total.....	186
9 years and under 10 years.....	9		
Total under 10 years.....	137		

But many of these men had kept on working after they were sick, going back when they were sufficiently recovered, and sometimes repeating this many times. Eighty-two of them gave a history of more than one attack of lead poisoning, of whom 19 used such expressions as "many," "several," "frequent," but 63 gave the actual number of attacks. They were as follows:

Number of employees.	Number of attacks.
21	2
25	3
10	4
4	5
2	8
1	12

A table giving the period of exposure before the effects of the poison were first felt is more illuminating than the length of employment before a particular attack. This could be ascertained in 94 cases only. They averaged 2.3 years' exposure.

NINETY-FOUR CASES OF LEAD POISONING IN THE GLAZE DEPARTMENTS OF 10 PORCELAIN-ENAMELED IRON SANITARY-WARE PLANTS, BY CLASSIFIED PERIODS OF EXPOSURE.

Period of exposure.	Cases of lead poisoning.	Period of exposure.	Cases of lead poisoning.
Under 1 week.....	1	3 years and under 4 years.....	9
Under 1 month.....	1	4 years and under 5 years.....	2
1 month and under 2 months.....	1	5 years and under 6 years.....	3
2 months and under 3 months.....	1	6 years and under 7 years.....	3
3 months and under 4 months.....	6	7 years and under 8 years.....	4
4 months and under 6 months.....	15	8 years and under 9 years.....	2
6 months and under 8 months.....	13	9 years and under 10 years.....	2
8 months and under 10 months.....	5	Total under 10 years.....	90
10 months and under 12 months.....	2	10 years and over.....	4
Total under 1 year.....	45	Total.....	94
1 year and under 2 years.....	9		
2 years and under 3 years.....	11		

As always, some men are seen to be much more susceptible to lead as a poison than others. The 25 men who sickened in less than 6 months were not necessarily more exposed to lead dust than those who worked 10 years before they felt any symptoms of sickness. Indeed, some of the former were working side by side with the latter.

It has not been possible to separate the cases of lead poisoning among enamelers from those among mixers nor to say what is the proportion of men in each of these two groups affected by lead poisoning. In 1 city there were reported 63 cases in 2 years among enamelers in a factory employing 143 enamelers, and 36 cases among mixers, the whole force of mixers numbering only 20. This was a

much larger number of cases among mixers than was heard of anywhere else, but in this city information was obtained from a night foreman who had been employed for many years in the mill department. Most of these cases were not sufficiently verified to have consideration in this study.

SEVERITY OF LEAD POISONING IN IRON SANITARY-WARE FACTORIES.

On this subject there are no figures from British sources to compare with those of this investigation. This industry is not, it seems, an important source of poisoning in Great Britain, for only three cases are attributed to it during the year 1909.

Serious cases of lead poisoning were found among these sanitary-ware enamelers, and yet not all the serious cases were located. Stories were told of men who had gone back to their old homes in Austria-Hungary broken in health, paralyzed, or dying, and sometimes these tales came from very trustworthy sources, but dates and details were lacking. Fairly full statements, however, were obtained from physicians, hospitals, or personal interviews concerning 177 of the 309 cases considered. Of these 28 had palsy, 12 such cases being reported by doctors, 16 by employers and men; 8 had the cerebral form of lead poisoning, 7 of whom were reported by doctors and 1 by a fellow workman.

Accepting only the professional information the following classification of 160 cases is obtained:

NUMBER AND PER CENT IN EACH CLASSIFICATION OF 160 PROFESSIONALLY DETERMINED CASES OF LEAD POISONING IN 10 PORCELAIN-ENAMELED IRON SANITARY-WARE PLANTS.

Classification.	Cases.	Per cent.
Severe.....	19	11.9
Moderate.....	77	48.1
Slight.....	64	40.0
Total.....	160	100.0

The percentage of severe and moderate cases is greater here than among the male potters.

Twelve cases were said to have ended fatally during these 2 years, 5 of whom were reported by the men, 7 by doctors and hospitals. These 7 would represent a mortality of $3\frac{1}{2}$ a year among 1,012 employed, more than three times as great a mortality as that among the potters.

EFFECT OF LEAD WITH REFERENCE TO NATURE OF THE WORK.

In considering the question of lead poisoning among iron sanitary-ware enamelers one must not overlook the influence of the excessive heat, of the bodily fatigue, and the irritating dust, all of which are

evils inherent in the work. The development of lead poisoning is, according to all authorities, favored by fatigue, heat, and irritating dust. Another feature of the work is the connection between lead poisoning and tuberculosis. The enamel dust is ground glass, extremely injurious to the lungs, and it is not surprising to find a great deal of tuberculosis among the men who handle it. A physician practicing near one of these factories had 20 patients die of tuberculosis during 7 years' time, all of them mixers or enamellers. It is well known that lead poisoning favors the development of tuberculosis.

IS DANGER OF LEAD POISONING INCREASING IN INDUSTRIES STUDIED?

In the section on lead poisoning in the white-ware potteries it was possible to say that according to information received from physicians and workmen it seems to have decreased markedly. As to the other branches of the pottery industry, tile making and art and utility ware, the testimony is not unanimous, but it is probable that here, too, there has been improvement. In the enameling of iron sanitary ware there is apparently in some factories less lead poisoning than formerly. One plant, for instance, is using less lead all the time and the manager is endeavoring to get away from its use altogether. In this town both the physicians and the employees of the factory assert that there is not nearly so much sickness among the men as there used to be. In two other towns conditions are said to have grown worse instead of better, and lead poisoning to be increasing. This, of course, is only hearsay evidence. So long as there is no compulsory registration of cases of industrial lead poisoning and no more accurate way of discovering cases than those here used, it can not be known whether matters are really improving or growing worse, and so long as formulas are secret and there is no legal control over the amount of lead in the enamel it is impossible to determine whether one plant is really more dangerous than another.

APPENDIX A.

HYGIENIC CONDITIONS AND REGULATIONS IN POTTERIES, TILE WORKS, AND ENAMELED SANITARY WARE WORKS IN GREAT BRITAIN, GER- MANY, AND AUSTRIA.

INTRODUCTION.

This inquiry was made during the summer of 1912 and covered potteries in Great Britain, Germany, and Austria making earthenware for toilet and table use, sanitary earthenware, glazed tiles, and enameled ironware for sanitary purposes, as these are the branches of industry investigated in the United States. Establishments were selected which use a lead glaze or a lead enamel and at the same time information was sought as to the attitude of the manufacturers toward the much-discussed question of leadless glaze and fritted glaze. It was evident that in these three countries the use of glazes containing soluble lead is recognized as dangerous for the workmen and in all the establishments visited various measures were found in force which had been introduced solely with a view to prevent lead poisoning among the glaze workers; measures more or less complete and efficient, but always far superior to those found in potteries in the United States. No British, German, or Austrian pottery was seen in which dust was tolerated in the dipping room, in which glaze scraping and brushing were carried on without any device for removing the dust, or which failed to provide a lunch room and wash rooms for the workpeople.

The hygiene of the industry differs very much in these three countries, being best controlled in Great Britain, least in Austria, with Germany in between. British potteries and tile works have apparently every possible device for the prevention of dust and for insuring personal cleanliness on the part of the workpeople. German potteries and tile works are more generously and beautifully built than the British, the mechanical arrangements for conveying clay and ware are much better, wash rooms and lunch rooms are always scrupulously clean and usually very attractive, but the system of dust prevention is not as well thought out as in Great Britain, and in consequence the dangers of ware cleaning are greater in German factories. Nor do they make as generous provision in the matter of washing facilities and working clothes as do the British. The larger Austrian potteries resemble the German but are inferior in construction and in dust prevention, while the smaller potteries in Austria are said to be bad.

In Great Britain these industries are governed by special rules which are modified according as the factory uses a glaze or enamel rich in lead or the reverse. The German law of 1887 is designed to protect the consumer, not the workman, for it simply prohibits the use of a glaze which would yield soluble lead after one-half hour's boiling with 4 per cent acetic acid, this being rendered necessary by the German habit of using earthenware for cooking purposes. Cases of food poisoning have been traced to the use of lead glazed ware in cooking. Efforts to introduce a law in Germany similar to the British law have met with decided opposition from the association of German master potters (*Verband Deutscher Keramiker*) who insist that the facts do not justify such legislation, that there is very little lead poisoning in this industry, and less each year. As will be seen later on, it is impossible to prove or disprove such a statement, because German statistics are incomplete, but whether or not there is need of further legislation in Germany, it is certainly true that many German employers have of their own initiative introduced into their potteries equipment and regulations measuring nearly up to those required in Great Britain. The "Verband" also declares itself in favor of the use of harmless glazes and urges all members to carry on experiments in leadless glaze and in properly fritted glaze.

One advantage of the British system of regulation is that it offers every inducement to the manufacturer to reduce the amount of soluble lead in his glaze and thus escape the irksome rules governing potteries in which the glaze has over 5 per cent soluble lead. The German and Austrian manufacturers have not this incentive.

In Austria there is no law regulating the pottery industry as such, nor the making of enameled ironware, but the factory inspectors have the power to insist upon the sanitary reforms which seem necessary in any individual plant.

The system of medical care for the workpeople who are exposed to lead is more thorough in Great Britain than in Germany and Austria. A physician paid by the employer and approved by the Home Office examines once a month all those who are exposed in any way to the effects of lead and reports all cases of lead poisoning to the Home Office. In Germany and Austria people suffering from lead poisoning, like all other sick working people, go to the doctors attached to the sickness-insurance office, and these doctors are not obliged to report cases of lead poisoning in Prussia or in Austria, but in Saxony the law requires them to do so. Obviously, even in Saxony, it is possible for cases to escape detection which would be brought to light under the routine examination practiced in British potteries.

The question of the composition of glazes and enamels was discussed with British, German, and Austrian experts. It is evident that there is an effort among the pottery manufacturers in all these countries to get away from the use of lead altogether whenever this is found to be possible and, when it is not, to frit the lead in such a way as to render it insoluble. In a large tile works in Velten (Prussia) a glaze was found in use which after careful fritting contains only 0.01 per cent of soluble lead. The original formula was given as follows:¹

	Parts.
Silica	156.0
Feldspar	55.9
Potassium nitrate	10.1
Sodium carbonate (anhydrous)	21.2
Tin oxide	60.0
Lead oxide	133.8
Kaolin	25.8

In a Meissen tile works and pottery 18 per cent of red lead enters into the mixture, but fritting reduces the amount of soluble lead to 3 to 4 per cent. The owner of an Austrian earthenware pottery which was visited claims to have a fritted glaze which is entirely harmless, though the Thorpe solubility test has not been applied to it. The formula is as follows:

Sand	392
Boric acid	39
Soda	17
Oxide of lead	260
Lime	188

This is fritted at a high temperature and is said to contain only traces of soluble lead.

Dr. L. Teleky gives the results of several analyses of glaze made for him by the royal food commission in Vienna (*Lebensmitteluntersuchungsanstalt*). A fritted glaze from Villeroy and Boch in Dresden gave only 0.9 per cent soluble lead, and one from a firm in Furstenwald, which frits at a high temperature, contained no soluble lead. On the other hand a poorly fritted glaze from a pottery in Meissen had almost as much soluble lead² as a nonfritted glaze from the same pottery, 56.17 per cent for the former, 61.3 per cent for the latter. One of the tile factories in Meissen that was visited was using a glaze for colored tiles which contained 30 per cent soluble lead. It is in the use of these glazes, rich in lead, that the superiority of British methods is seen, for, as far as the avoidance of glaze dust is

¹ Keramischer Rundschau, Vol. 20, p. 79.

² The term soluble lead always means the amount of lead soluble in 0.25 per cent hydrochloric acid, according to the Thorpe test. See Rule No. 2, special rules for the manufacture and decoration of earthenware and china in Great Britain, Appendix B of this report, p. 83.

concerned, the British tile works are much better managed than the German.

In general it may be said that while the legal regulation of this industry is not as strict in Germany and Austria as in Great Britain, yet the employers in these countries are alive to the danger of the use of lead glazes and are trying to lessen it by improving the composition of the glaze and by protecting the workmen. The following is a more detailed account of the way in which glaze is handled in British, German, and Austrian potteries and the care that is given to the working people:

BRITISH POTTERIES AND TILE WORKS.

Three potteries making table and toilet ware were visited in Staffordshire, namely, the Doulton Co., in Burslem; the Grindley Hotel Ware Co., in Burslem; and the Star China Co., in Langton. The factories are not as large and roomy as are the best in the United States, but are also not as dark and crowded as are the worst. In hygienic construction they are immeasurably superior to the best in New Jersey and Ohio. The dipping rooms are constructed so as to allow of perfect cleaning and they are kept clean. The floors of these rooms are of cement or dust brick which shows plainly the white drops of glaze and makes it easy to control a careless dipper. Splashing is never allowed, for it is wasteful as well as dangerous. The floors are never swept dry but are washed with mops or flushed from a hose every evening. The walls also are of smooth, impermeable, painted plaster or of tiles, so that they can be washed free from dust.

In the three potteries visited the dipping rooms were very attractive, that at Grindley's being especially so; a one-storied building, well lighted and ventilated from the roof, with a dark red tile floor contrasting pleasantly with the white-glazed tiles which covered the walls. Such a room can be washed from ceiling to floor.

There are various devices for preventing the dipper from splashing glaze on walls and floor, but all are essentially screens of wood or zinc, guarding all the circumference of the tub except the place where the dipper stands working, or there may be a cover over all but a third of the tub and the dipper then works under this cover.

One does not usually find a "taker-off" working beside the dipper's drip board as in our potteries, although this is sometimes seen. In such cases the dipper places the ware on a board which stands so as to drip back into the tub and the taker-off lifts it off. Never is the glaze allowed to fall anywhere but back into the tub, a matter of economy as well as precaution against dust.

In these three potteries the dippers placed their ware at once on a so-called "mangle," which consists of a series of grated shelves traveling along an endless belt within a heated compartment. At the other end stood a girl taker-off and removed the now dried ware.

Glost kilnmen do no ware cleaning; they only place the ware in the saggars. Ware cleaning or finishing is done dry, with knives called "fettles," or sharp sticks, or stiff brushes, or it is done wet with sponges or wet flannel, but always with every possible precaution against dust. When dry rubbing or scraping must be used, the man or woman, more often the latter, works over a large vessel or shallow sink of water, which catches all the heavier particles of glaze, and in front of or over an air exhaust, which carries off the lighter particles. There are various devices used. In one pottery a man was rubbing the bottoms of small saucers across rough flannel fastened to a long board. In front of the board, between it and the man, was a shallow trough of water, and behind the board ran the long opening of an air exhaust drawing away the dust raised by the rubbing. In another, the girl taker-off at the mangle had before her a long shallow tank in which stood two boards covered with flannel, not under the water but saturated by it. From the center of the tank projected the opening of an air exhaust covered with netting. The girl took two cups off the mangle, rubbed the foot of one against the other, holding them over this exhaust, then gave each a quick rub over the wet flannel.

Other ware needs more thorough cleaning, with fettle and brush. Here women were found scraping and brushing off the glaze into shallow sinks filled with water, along the farther side of which ran an opening about 6 inches high, with a strong exhaust leading into the dust-collecting system. The glaze deposited from these exhaust pipes is used to finish the inside of saggars; the glaze caught in the water can be used for ware again. It is claimed that it is an economy to collect excess glaze in water instead of letting it fall on the floor to be swept up with dust and dirt.

The boards on which the glazed ware is placed and the shelves on which it is stored before firing are beautifully clean. These boards must be washed every evening.

Decorating rooms are not superior to those in the United States. The proposed new rules which are still under consideration will require the floors in these rooms to be of some impervious material, but at present they are made of wood, and color is blown and dusted on ware at wooden tables. The hoods used over the color blowing to carry off the dust are like those in our potteries, except that it is more usual in England to have the sides and top made of glass, a good thing, for it allows one to see whether the color dust is really carried off by the exhaust. In one pottery the sides of the hood sloped together toward the front, thus narrowing the opening.

Majolica painting and glazing was seen in the Royal Art Pottery in Langton. Here all the arrangements for preventing splashing and for removing glaze dust which have been described above were

found, and it is unnecessary to go into details. The processes used are similar to those used in Zanesville art potteries, but the contrast between this place and the ones visited in Zanesville is very great. The English majolica pottery owner has succeeded in rendering the work almost dustless; certainly no possible precaution seems to have been neglected. The two tile factories visited were Minton & Hollins, in Stoke-upon-Trent, and Malkin's, in Burslem. In these two factories the abolition of glaze dust strikes an American observer as even more remarkable than in the potteries, perhaps because American tile works are greater offenders in the matter of dust than are the potteries. At Minton & Hollins colored tiles are dipped by hand so skillfully as to need no subsequent cleaning. Colored cornices and other irregular shapes are painted with a brush, and as soon as each is finished it is taken by a cleaner and scraped before the glaze has had time to dry. The damp glaze drops into a pan of water and is used again. Great care is taken not to waste it by letting it fall on the table or floor. In both these factories it is the rule to fettle all tiles that need cleaning at once, before they are dry, and never let them accumulate. Usually a dipper has three or four helpers, one to pass the dipped tiles to the others for cleaning. Majolica tiles are finished at once by the decorator himself.

The dipping rooms in these factories are excellently constructed, especially the ones in Malkin's, which are very light and well aired, with white tiled walls and a red tiled floor sloping to a drain, so that it can be flushed with a hose.

The glaze for colored tiles contains, of course, much more lead than that for white tiles, and the glazing of the two kinds is carried on in separate rooms. Colored tiles are placed in saggars by the dippers; white tiles are placed by special workers in a separate room, but these people come under the same rules as other glaze workers.

The greatest contrast between British and American potteries and tile works is seen in the attention paid to the personal care of the workpeople. All the factories visited come under the special rules which apply to places using a glaze containing more than 5 per cent soluble lead. These rules apply to every person who comes in contact with the glaze in any way, even if he is only working in the same room with dippers or cleaners. This, of course, leads to a strict separation of safe from dangerous processes, such as does not obtain in many American potteries and tile works.

The glaze workers are furnished with full suits of washable working clothes, washed weekly and mended at the expense of the employer. Men wear overalls and caps, women full, high-necked, and long-sleeved aprons of some light-colored calico. There was at first a good deal of opposition on the part of the girls to wearing caps, but a clever factory inspector devised a pretty shirred sunbonnet

which sits loosely on the head and is very becoming. One sees light blue, pink, and lavender, the girls choosing the color they like. The bonnets are very inexpensive.

Toilet rooms must contain one basin with hot and cold running water for every five employees, and roller towels, soap, and nail-brushes. The workpeople are required to take off their work clothes, and wash hands and face, before leaving work or going into the lunch room, the only place where they are permitted to keep and eat food. It is customary to allow one-quarter of an hour in the middle of the morning and afternoon and one hour at noon. The lunch rooms in British potteries are for the most part unattractive and untidy and can not bear comparison with those in German potteries, but the difference lies in the workpeople rather than in the employers.

The men and women employed in the Staffordshire potteries look for the most part in excellent health, the girls with beautiful, blooming complexions, but it would hardly be fair to compare them with the workers in our potteries, for Americans in every walk of life are paler and less robust looking than the English.

In discussing the question of State regulation of the pottery industry, very strong opposition was usually expressed in Staffordshire to any suggestion of the prohibition of lead glaze, but no criticism was made of the rules protecting the workpeople against lead poisoning. As can be seen, these rules involve expense and continual vigilance on the part of the employer, yet not only are they accepted, but in some instances employers have gone beyond the requirements of the law. Thus in the Malkin Tile Works a physician is employed to attend to all the ailments of the women employees, in addition to the physician who once a month examines them for symptoms of plumbism. This factory furnishes hot milk free each morning to all the people who come under the special rules. There is a charmingly fitted-up lunch room with walls of decorated tiles, and the employers provide a stove and fuel and the services of a housekeeper, who cooks the food which the workpeople club together to buy. In this way they can have a hot meat dinner for the sum of 3½d. (7 cents).

GERMAN POTTERIES AND TILE WORKS.

The German pottery industry is different in many ways from the British and therefore from our own, which is, of course, of British origin. Moreover, the methods used in parts of Germany are different from those in potteries in other regions making similar ware. Stove tiles in Prussia are glazed in one way, in Saxony, Bavaria, and Silesia in quite another way. Roof tiles are mostly unglazed; others are covered, as in America, with a leadless glaze; but, in some places, the Düsseldorf region for instance, a glaze with a large amount of lead is used.

In the Berlin district stove tiles are covered with an opaque glaze containing oxides of tin and of lead, which are very thoroughly fritted. These are known as "Schmelzkacheln." In Saxony, Bavaria, Silesia, and in Austria a transparent glaze is used, soft, rich in lead, which has been only partially fritted, if at all. For white tiles the glaze may have from 10 per cent to 60 per cent lead oxide; for colored, from 40 per cent to 80 per cent. These tiles are "Begusskacheln."

One great drawback of the pottery industry in Prussia and in Austria is that instead of using already prepared lead oxides for the glaze, metallic lead, with tin usually, is oxidized in furnaces in the pottery, and there is thus added a new element of danger for the workmen. Indeed, in the Velten district in Prussia, where a red-clay body is used and must be covered with an opaque glaze, this oxidizing of tin and lead is general and is said to be responsible for almost all the cases of lead poisoning in these potteries.

Earthenware for sanitary use is covered with a leadless glaze, table and toilet ware with a lead glaze, usually only partly fritted, for most of the lead oxide—rarely white lead—is added after the fritting process. According to Dr. Kaup, in the potteries of the upper Palatinate all the lead is fritted with sand sufficient to combine with it and produce the higher silicates of lead, and in consequence lead poisoning has vanished from this part of the country.

The potteries visited in Germany were the Veltener Ofenfabrik, of Blumenfeld, near Berlin, where white and colored tiles are made; the Meissner Ofen- und Porzellan- Fabrik, C. Teichert, in Meissen, making tiles and porcelain; and the Dresden branch of Villeroy & Boch making sanitary ware, table and toilet ware, and tiles. These are all large, modern, beautifully constructed factories, with brick or tiled floors, tiled walls, ample light and air, and so high a standard of cleanliness that in many rooms one could quite literally eat off the floor.

The Veltener factory is an example of Prussian tile works, where the glaze used is practically harmless. The formula for this glaze has already been given.

After thorough fritting the lead is converted to the higher silicate, and the report from the Government laboratories gave the amount of soluble lead as only 0.01 per cent.

In this pottery there are only three places where there is any danger of lead poisoning. The chief one is in the preparation of the lead oxide. Metallic lead and tin are melted together and oxidized in furnaces. The usual precautions against the escape of fumes are employed here, but it is said that all the cases of lead poisoning in the factory came from the furnace gang. The second place is in the mixing room, where, however, such scrupulous cleanli-

ness is observed that one does not see how a case of dust poisoning could occur.

The handling of the glaze, especially in ware cleaning, is not nearly as careful as in England, but as the glaze is practically free from soluble lead there would be no need of such precautions. Safe as it is, it is used with decidedly more care than are our soluble lead glazes in America.

The third place where there is danger of lead poisoning is in the making of onyx tiles. Lead colors are used and are applied by means of sponges or atomizers. No women are employed in any of these departments in this factory. Thirty men in all come in contact with lead in making and handling the glaze. Working clothes are not provided here, nor are the washing accommodations at all abundant, and there is no medical examination of the employees. The officials state that they average a little less than two cases of lead poisoning a year, and that these men always come from the furnace rooms.

As was stated above, the Dresden tile industry differs from the Berlin in that a nonfritted or partially fritted glaze is used, containing often a large quantity of soluble lead. C. Teichert, in Meissen, uses for wall tiles a glaze containing 90 to 95 per cent of frit in which 10 to 20 per cent of red lead has been fused with large quantities of silica and supposedly rendered insoluble, but this point has not been verified by test. The experiment in fritting was made in order to lessen the dangers of lead poisoning, and the fritted glaze has been found to be entirely free from any disadvantages. For stove tiles the problem is quite different, and so far it has been impracticable to use for these a fritted glaze. It was explained that the body of the stove tiles is made of clay which will not take a glaze very rich in silicic acid, for it would be too inelastic and would craze. As much as 60 or 65 per cent of red lead is used for these tiles, and the Thorpe test is said to show the presence of 10 to 30 per cent soluble lead.

Mixing is carried on in a room which has a smooth brick floor and is kept scrupulously clean, but there are no dust removing exhausts, and an open tub is used for the mixing of ingredients.

White tiles for walls are glazed by means of machines like those used in the United States and, as in our factories, need no scraping or brushing. There are also machines for colored tiles. These tiles are placed right side up on a traveling belt which carries them through a closed chamber under a spray of colored glaze. Irregular shapes are glazed in the same way. Large tiles, such as are used for stoves, are glazed by pouring and these need scraping and brushing. Women and girls scrape them with knives and rub them with heavy felt, letting the glaze fall into pans on the table. There is no water

to catch the heavy glaze and no exhaust to carry off the lighter part, though there is really not much dust, for the glaze is still a little damp. Still the English way of managing this part of the work is undeniably better. In this factory decorated tiles are mostly colored under the glaze with leadless colors applied by decalcomania or atomizer.

Seven hundred persons are employed here and out of this force 40 to 50 women and 24 to 30 men come in contact with glaze as dippers and cleaners. In addition, there are 45 placers and glost kilnmen. As in England, safe processes are separate from dangerous; pressers and dippers do not work in the same room. There is also a noticeable absence of dust throughout the works, in great contrast to American tile factories. In the flint grinding room, for instance, there is very little dust to be seen, because the mills are well inclosed in wooden frames and are furnished with exhaust pipes which carry off the dust and deposit it in bags, mechanically shaken and emptying into closed hoppers. The mill was open at the time the visit was made and a man was shoveling in flint but he worked carefully and the draft was strong enough to draw the dust in from the opening.

In the pressroom also, where the tiles are formed, there are large fans in the ceiling to carry off the dust. As all authorities assure us that irritating dusts act as predisposing cause of lead poisoning, their removal must be looked upon as one of the measures of prevention of this disease, especially where, as is the case in some American factories, pressing and glazing go on in the same room.

The factory of Villeroy & Boch, in Dresden, manufactures sanitary ware with a leadless glaze, table and toilet ware and tiles with a lead glaze. It is a beautiful factory, very spacious, with high ceilings, floors of red and white brick, and walls covered up to a height of 8 feet with gaily patterned tiles. A large dipping room accommodates 60 men and women engaged in dipping and finishing table and toilet ware. They dip by hand only the largest and smallest pieces; the others they grasp by means of long-handled, three-pronged forceps, so that the dipper's hand does not come in contact with the glaze at all. Each piece is whirled in the air for a few seconds to dry the glaze and not placed on the receiving board till it is too dry to drip. To prevent scattering of drops the dipping tubs are provided with guards of sheet zinc, as in England.

The little marks left in the glaze by the ends of the forceps are usually smoothed off at once by the dipper's finger, though even this is not necessary in the case of the smaller ware handled with tiny forceps. More extensive ware cleaning is done with thick felt or knives. The women are supposed to do it over the opening of an air exhaust, but really much of it is done right at the receiving boards.

There is not nearly as much care shown in this part of the work as there is in England, but the glaze used for this ware is fritted and contains only from 3 to 5 per cent of soluble lead.

In the tile division, also, there are not as many precautions taken as in the English works visited. The dippers splashed glaze more and the finishers had allowed tiles to accumulate and dry before scraping off the excess of glaze. The work, however, was not as dusty as that seen in some American factories, where the finishers brush and blow away the glaze.

There are 200 persons regularly employed as dippers, cleaners, placers, and kilnmen, and 15 more who work twice a year for periods of four or five weeks making up the semiannual supply of glaze. During the last four years no case of lead poisoning has come to the notice of the sickness-insurance physicians. Certainly this is a record to be proud of.

AUSTRIAN POTTERIES AND TILE WORKS.

In Austria as in the United States there is no law regulating the hygiene of this industry as such and there is no compulsory registration of cases of lead poisoning. Factory inspectors insist upon certain essentials in the matter of cleanliness and lunch rooms separate from the workrooms, but one of the factories which was visited had never been inspected and was therefore quite at liberty to neglect all precautions. Nevertheless it seems, to judge from the instances seen, that the owners of large potteries in Austria do not need to be compelled to provide at least the essentials for the protection of their workmen. For instance, in the Wieneberger tile works in Vienna, where 550 workpeople are employed, every effort is made to render the work dustless. The clay used for tiles is slightly dampened before pressing, and the pressroom is singularly free from dust. In the dipping rooms the tiled floors are washed daily, the tables are washed daily, and the ware is cleaned over or in front of an air exhaust. The workpeople are provided with special clothing and head covering; there are well-equipped dressing rooms and a separate lunch room. In the earthenware pottery of Lichtenstern Bros., in Wilhelmsburg, the glaze mixing, grinding, and fritting is carried on in an open shed to avoid dust.

Neither of these potteries comes up to the British standard of safety, but both are superior to American potteries.

COMPARISON OF CONDITIONS IN AMERICAN AND FOREIGN POTTERIES.

If we should sum up the points of superiority in these foreign potteries and tile factories as compared with those in the United States, we should find that the first one is the recognition on the part of the foreign employer that the handling of lead glaze is a dangerous trade, and that the workman engaged in it needs protection. The means adopted to protect him, which are not found in

American factories, are the following: Efforts to lessen the amount of soluble lead in the glaze by careful fritting; constructing the mixing, grinding, dipping, cleaning, and placing rooms with hard, smooth floors easily kept clean; prevention of splashing from the dipping tubs by properly constructed screens; catching the heavy glaze scraped off by the cleaners in water and carrying off the lighter particles by means of air exhausts; providing and requiring the use of clean, washable working clothes and caps, and of properly equipped wash rooms; forbidding the workmen to keep or eat food in any room except the lunch room; subjecting all glaze workers and decorators to a monthly medical examination.

All of these reforms could be introduced into potteries and tile works in the United States without necessitating any change in methods of manufacture.

LEAD POISONING IN BRITISH, GERMAN, AND AUSTRIAN POTTERIES.

The British regulations in the potteries have resulted in a great reduction in the number of cases of lead poisoning among potters and decorators. As the annual reports of the factory inspection department of the Home Office give full statistics as to the numbers employed, men and women, in the various occupations exposing them to lead, and the number of cases of lead poisoning occurring each year, it is easy to trace the effect of the sanitary control of this industry in Great Britain. The regular monthly medical examination insures the detection of early cases and of mild chronic cases, for all authorities agree that unless all the working force comes under the eye of a physician at regular intervals some of these cases will escape discovery. As neither Germany nor Austria has this system of medical control, it follows that their information concerning lead poisoning in the pottery industry is incomplete. It would be very interesting to compare the results of the different methods in these countries as shown by the proportion of cases of lead poisoning among the workmen in each, but German and Austrian reports are not full enough to make this possible. A search for usable and comparable statistics of lead poisoning in the German and Austrian ceramic industries is bewildering and could be successful only if one had unlimited time to devote to it, and after conference with such authorities as Prof. Albrecht and Dr. Kaup, of the Central-stelle für Volkswohlfahrt in Berlin, Councilor Hübener, of Dresden, and Dr. Teleky, of the University of Vienna, it was decided to give up the attempt.

It is not possible to discover from the published reports how many ceramic workmen in Germany and in Austria are exposed to lead and how many of them contract lead poisoning in the course of a year. To ascertain these facts it would be necessary to visit all the factories and inquire as to the number employed in such work in each one, and then to go through the archives of the sickness-

insurance office and pick out the cases. The yearly report of the factory inspection department of Saxony (*Jahresbericht des königlich Sächsischen Gewerbe-Aufsichtsbeamten*) for the year 1910 gives the number employed in 71 potteries as 6,760 and in 144 tile factories as 4,146, but this includes workmen in all the departments and also includes potteries which use a leadless glaze. Having only this to go on, it is quite impossible to say whether the 22 cases of lead poisoning which were reported as having occurred in potteries and tile works during this year represent a small or a fairly large proportion of those engaged in handling the glaze, yet nothing more detailed than this can be found. It is not possible to find out from the report to which sex the 22 cases belong, what sort of work they were doing, or what sort of glaze they were handling.

In Prussia even the number of cases of lead poisoning occurring in a year is not known, because there such cases are not reported. The authorities who were interviewed said that there could not be much lead poisoning in the potteries or the attention of the sickness insurance office would have been called to it and an inquiry instituted. The use of well-fritted glaze in the Prussian tile works makes it probable that there is less trouble there than in Saxony.

Dr. Kaup, of the Centralstelle für Volkswohlfahrt in Berlin, has made a study of lead poisoning in the ceramic industries in Germany, collecting all the available information on this subject, and he believes that the amount of industrial plumbism among this class of people is not indicated by the reports of the sickness insurance office or by the records of hospitals, because many workpeople do not seek hospitals or even visit physicians unless they feel themselves to be seriously ill. For instance, in the Freiburg region not one case had been reported, but a factory inspector expressed the belief that 10 per cent of the women in the potteries were suffering from lead poisoning. Dr. Kaup is thoroughly in favor of legislation requiring regular medical examination and registration of all cases. He thinks there is no evidence that the cases are diminishing. In Velten in 1901, 1,748¹ persons were employed in ceramic work and 4 cases of lead poisoning are recorded in the sickness insurance office. In 1905 the number of workers had increased to 2,500, but the cases to 14.

Dr. Ludwig Teleky, who occupies the chair of social medicine in the University of Vienna, estimated that there are 10,522 persons employed in making tiles and cheap earthenware in Austria-Hungary, and that 5,000 of these are exposed to lead, this large proportion being explained by the fact that 84 per cent of the establishments employ less than 5 persons, and in such small potteries all the workmen must come in contact with the glaze. Lead glazes usually

¹These figures represent all employes, not glaze workers only.

contain from 40 to 80 per cent of lead oxides and are rarely fritted. One advantage of the small pottery is that many of them buy their glaze already prepared, thus escaping the dangers not only of mixing and grinding, but also of burning the lead to make the oxides, a procedure which is common in the larger Austrian potteries as it is in the Prussian. The cheapest ware does not require cleaning, another advantage, but in general the small potteries are dusty, crowded, and insanitary, and when the work is carried on in the potters' homes it endangers the health of the family as well as of the workmen.¹ It is in this part of the industry that Dr. Teleky sees most need of legislative control. He states that, in the absence of medical examination of the pottery workers and registration of cases of lead poisoning, it is impossible to say how much of the latter is present in the potteries and tile works of Austria-Hungary. In Vienna, during five years' time, 36 cases of plumbism came under the care of the sickness-insurance physicians. These all came from 12 potteries, where the regular force employed in glaze work was not over 25 persons.

PORCELAIN-ENAMELED SANITARY WARE.

It is not so easy to compare the factories making this ware in the United States with foreign factories as it was in the case of potteries and tile works, because the great majority of British and German factories use a leadless glaze for porcelain enameled bathtubs, sinks, and basins. In Great Britain it was stated that the use of leadless enamel had been adopted in order to escape the onerous requirements made by the factory inspection department when lead enamel is used, but in Germany it is claimed that leadless enamel is superior in durability; that while lead enamel is at first smoother and more shining, it quickly loses these properties under the action of soap and hot water, becoming roughened, dull, and hard to clean. Leadless enamel is less beautiful to start with but lasts much better. The factory at Thale, the Wuppermann Works in Pinneberg, and the Eschebach works in Radeburg are all said to use leadless enamel. The same is said to be true of the Doulton works in Paisley, Scotland. In neither Great Britain nor Germany is this trade looked upon as a dangerous one, and very little is said of it in factory inspection reports. German experts were surprised to hear it spoken of as a lead trade at all.

In Austria, on the other hand, ironware is enameled with a dry glaze rich in red lead, and in this country the industry is regarded as decidedly dangerous. One Austrian stove works was visited in

¹ For a description of the effects on the workers of home manufacture of pottery, see article on "Industrial lead poisoning in Europe," by Sir Thomas Oliver, Bulletin of the United States Bureau of Labor, No. 95, pp. 55 to 58.

which gas stoves are enameled by a process identical with that used in the United States for sanitary ware and with no more care than is seen in the latter. Both the enamellers who were interviewed had had lead poisoning, one of them recurring attacks of colic, the other of palsy.

The most valuable suggestions as to what can be done to protect workmen against lead poisoning when they are dusting dry lead enamel over a heated surface were obtained in an English bathtub works; and the best system of mixing and grinding was seen in the Dresden branch of Villeroy & Boch, where a fritted glaze is made, which is, for all practical purposes, identical with the enamel used in our hollow-ware factories and may serve as a model for the mill department of the latter as well as a model for potteries.

In Villeroy & Boch's pottery there is a separate building devoted to the preparation of fritted lead oxide glaze, which is made up in enormous quantities twice a year. For four or five weeks, spring and fall, about 15 men are employed here. Beginning on the top floor of this building we find a storeroom where all the ingredients of the glaze except the red lead are kept in bins and sent down through chutes to closed receptacles in the room below, the mixing room. Here they are weighed on large scales which stand under a hood with an exhaust. The red lead is kept and weighed in a small room adjoining. This room is all tiled and the white walls would show plainly any deposit of red-lead dust, but it is flushed daily, the water running off through a drain in the floor. The red lead falls from a storeroom above into a closed bin, the sliding door of which opens under a hood with an exhaust. Here there is a shelf holding the scales; the lead is weighed into a box and then carried into the mixing room, to be added last of all to the ingredients of the glaze. There are hoods with air exhausts over the intakes and the vents of the mixer, and it is excellently inclosed so that no leaking can take place. Mixing rooms and mill rooms have smooth tiled floors and are washed, not swept.

The charging of the fritting ovens is said to be free from dust, but this detail could not be observed. The fritted glaze runs out into water. It is said to contain from 3 to 5 per cent of soluble lead.

In this factory, therefore, the lead oxide is handled as a poisonous substance should be handled, and the result of this clear recognition of the danger and careful precautions against it is seen in the fact that no case of lead poisoning has been reported to the sickness insurance office for the last four years. It would be hard to find a greater contrast than that presented by this glaze mill and the one in a certain sanitary ware factory in the United States where every room in the building and even the passages and stairways are thick with enamel dust.

The porcelain enameled sanitary ware made by A. Hutchinsen & Son (Ltd.), London, has a lead enamel, but the firm is now experimenting with a leadless one of unknown formula made in France. This factory is interesting, because the methods employed are the same as those in American factories making similar ware, and yet a very small proportion of enamelers in this factory suffer from lead poisoning, which shows that in order to protect his workmen an American manufacturer would not be obliged to make radical changes in his methods of work. About 20 enamelers, 2 slushers, and 4 mill hands are employed in this factory, using an enamel containing soluble lead, the amount of which lead was not stated, but the factory comes under the rules prescribed for places using as much as 5 per cent soluble lead. The average number of cases of lead poisoning in this factory employing 26 men is one case in two years' time, as shown by the records of the doctor who examines all the men once a month.

When one compares these figures with those given in the section on lead poisoning among enamelers and mill hands in the United States one is inclined to think that quite extraordinary precautions must be taken in the English factory to bring about such a result, but in reality the means used are most simple and obvious. The enamelers wear not only full suits of overalls, washed weekly, but hats made of white duck, which are also washable. They have pieces of muslin or thick cheesecloth folded in many layers, which they tie over the lower part of the face in such a way that it can be drawn up when needed and slipped down in the intervals of work. When the cloth is drawn up it meets the brim of the hat behind and leaves no part of the hair exposed. Experience has shown that the use of these cloths can be insisted on, while the men rebel against the hot, heavy rubber, and sponge respirators.

The enamel rooms are small, and yet are cleaner, less dusty, than are most of those in the United States. Above the furnace, in the wall, is a fan with a strong draft, about 4 feet above the men's heads. This draft is, of course, not strong enough to draw off all dust, but it helps. After each enameling the men take long-handled brushes and brush down the beams of the ceiling, so that no dust accumulates. No dry sweeping is ever allowed.

The men have a wash room with hot water, one basin for every 5 men, shower baths, soap and towels, and toothbrushes. One of the most important features is the granting of two short pauses for lunches, and one of an hour for the midday meal. The men leave their workrooms, take off their overalls, wash hands and face, and eat their lunch in a room free from enamel dust. Thus they avoid two great dangers to which enamelers in the United States are exposed, for our enamelers must either eat food which has been kept

in an atmosphere of lead dust, and which they must take without stopping to wash hands or faces, or else they must go fasting for the six or eight hours of their shift, and it is hard to say which of the two is more conducive to lead poisoning.

When the monthly medical examination of all the men engaged in making and handling the enamel is added the list of measures which are used in this factory for the protection of the men is completed. They are not revolutionary nor extravagant, and it would seem entirely possible to introduce them into factories in the United States. If by so doing the amount of lead poisoning could be reduced from one in three to one-half in 26, it is probable that the reforms would eventually pay for themselves in the increased efficiency of the men.

APPENDIX B.

REGULATIONS FOR FACTORIES AND WORKSHOPS IN CERTAIN INDUSTRIES USING LEAD.

GREAT BRITAIN.

PART II.—SPECIAL RULES.¹

FOR THE MANUFACTURE AND DECORATION OF EARTHENWARE AND CHINA.²

Amended special rules established, after arbitration, by the awards of the umpire, Lord James of Hereford, dated December 30, 1901, and November 28, 1903.

Duties of occupiers.

1. Deleted.

2. After the first day of February, 1904, no glaze shall be used which yields to a dilute solution of hydrochloric acid more than 5 per cent of its dry weight of a soluble lead compound calculated as lead monoxide when determined in the manner described below.

A weighed quantity of dried material is to be continuously shaken for one hour at the common temperature, with 1,000 times its weight of an aqueous solution of hydrochloric acid containing 0.25 per cent of HCl. This solution is thereafter to be allowed to stand for one hour and to be passed through a filter. The lead salt contained in an aliquot portion of the clear filtrate is then to be precipitated as lead sulphide and weighed as lead sulphate.

If any occupier shall give notice in writing to the inspector for the district that he desires to use a glaze which does not conform to the above-mentioned conditions, and to adopt in his factory the scheme of compensation prescribed in schedule B, and shall affix and keep the same affixed in his factory, the above provisions shall not apply to his factory but instead thereof the following provisions shall apply.

All persons employed in any process included in schedule A other than china scouring shall be examined before the commencement of their employment or at the first subsequent visit of the certifying surgeon, and once in each calendar month by the certifying surgeon of the district.

The certifying surgeon may at any time order by signed certificate the suspension of any such person from employment in any process included in schedule A other than china scouring, if such certifying surgeon is of opinion that such person by continuous work in lead will incur special danger from the effects of plumbism, and no person after such suspension shall be allowed to work in any process included in schedule A other than china scouring without a certificate of fitness from the certifying surgeon entered in the register.

Any workman who, by reason of his employment being intermittent or casual, or of his being in regular employment for more than one employer, is unable to present himself regularly for examination by the certifying surgeon, may procure himself at his own expense to be examined once a month by a certifying surgeon, and such examination shall be a sufficient compliance

¹ Factory and Workshop Acts, Dangerous and Unhealthy Industries. Regulations and Special Rules in force on Jan. 1, 1908. London, 1907.

NOTE.—This print contains the codes of regulations and special rules (subject to the exception mentioned on p. 150) in force on Jan. 1, 1908, in places under the factory acts. The regulations appear in Part I of the print. They have been made under the procedure enacted by the Factory and Workshop Act, 1901 (secs. 79–86), in substitution for the “special rules” procedure of the earlier factory and workshop acts. Regulations apply automatically to all places of the class for which they are made. The special rules appear in Part II. They are made under the procedure enacted in the Factory and Workshop Acts, 1891 and 1895, and are not in force at a factory or workshop until they have been established individually for that factory or workshop. The codes of special rules are being gradually replaced by regulations under the act of 1901.

² This code superseded those of 1894, 1898, and 1901, which, however, are still in force in a few works. The question of making regulations to supersede all four codes is under consideration.

with this rule. The result of such examination shall be entered by the certifying surgeon in a book to be kept in the possession of the workman. He shall produce and show the said book to a factory inspector or to any employer on demand, and he shall not make any entry or erasure therein.

If the occupier of any factory to which this rule applies fails duly to observe the conditions of the said scheme, or if any such factory shall by reason of the occurrence of cases of lead poisoning appear to the secretary of state to be in an unsatisfactory condition, he may, after an inquiry, at which the occupier shall have an opportunity of being heard, prohibit the use of lead for such time and subject to such conditions as he may prescribe.

All persons employed in the processes included in schedule A other than china scouring shall present themselves at the appointed time for examination by the certifying surgeon, as prescribed in this rule.

In addition to the examinations at the appointed times, any person so employed may at any time present himself to the certifying surgeon for examination, and shall be examined on paying the prescribed fee.

All persons shall obey any directions given by the certifying surgeon.

No person after suspension by the certifying surgeon shall work in any process included in schedule A other than china scouring without a certificate of fitness from the certifying surgeon entered in the register. Any operative who fails without reasonable cause to attend any monthly examination shall procure himself, at his own expense, to be examined within 14 days thereafter by the certifying surgeon, and shall himself pay the prescribed fee.

A register in the form which has been prescribed by the secretary of state for use in earthenware and china works shall be kept, and in it the certifying surgeon shall enter the dates and results of his visits, the number of persons examined, and particulars of any directions given by him. This register shall contain a list of all persons employed in the processes included in schedule A, or in emptying china biscuit ware, and shall be produced at any time when required by His Majesty's inspector of factories or by the certifying surgeon.

3. The occupier shall allow any of His Majesty's inspectors of factories to take at any time sufficient samples for analysis of any material in use or mixed for use:

Provided, That the occupier may at the time when the sample is taken, and on providing the necessary appliances, require the inspector to take, seal, and deliver to him a duplicate sample.

But no analytical result shall be disclosed or published in any way except such as shall be necessary to establish a breach of these rules.

4. No woman, young person, or child shall be employed in the mixing of unfritted lead compounds in the preparation or manufacture of frits, glazes, or colors.

5. No person under 15 years of age shall be employed in any process included in schedule A, or in emptying china biscuit ware.

Thimble-picking, or threading-up, or looking-over biscuit ware shall not be carried on except in a place sufficiently separated from any process included in schedule A.

6. All women and young persons employed in any process included in schedule A shall be examined once in each calendar month by the certifying surgeon for the district.

The certifying surgeon may order by signed certificate in the register the suspension of any such woman or young persons from employment in any process included in schedule A, and no person after such suspension shall be allowed to work in any process included in schedule A without a certificate of fitness from the certifying surgeon entered in the register.

7. A register, in the form which has been prescribed by the secretary of state for use in earthenware and china works, shall be kept, and in it the certifying surgeon shall enter the dates and results of his visits, the number of persons examined in pursuance of rule 6 as amended, and particulars of any directions given by him. This register shall contain a list of all persons employed in the processes included in schedule A, or in emptying china biscuit ware, and shall be produced at any time when required by His Majesty's inspector of factories or by the certifying surgeon.

8. The occupier shall provide and maintain suitable overalls and head coverings for all women and young persons employed in the processes included in the schedule A, or in emptying china biscuit ware.

No person shall be allowed to work in any process included in the schedule, or in emptying china biscuit ware, without wearing suitable overalls and

head coverings: *Provided*, That nothing in this rule shall render it obligatory on any person engaged in drawing glost ovens to wear overalls and head coverings.

All overalls, head coverings, and respirators, when not in use or being washed or repaired, shall be kept by the occupier in proper custody. They shall be washed or renewed at least once a week, and suitable arrangements shall be made by the occupier for carrying out these requirements.

A suitable place, other than that provided for the keeping of overalls, head coverings, and respirators, in which all the above workers can deposit clothing put off during working hours, shall be provided by the occupier.

Each respirator shall bear the distinguishing mark of the worker to whom it is supplied.

9. No person shall be allowed to keep, or prepare, or partake of any food, or drink, or tobacco, or to remain during meal times, in a place in which is carried on any process included in schedule A.

The occupier shall make suitable provision to the reasonable satisfaction of the inspector in charge of the district for the accommodation during meal times of persons employed in such places or processes, with a right of appeal to the chief inspector of factories. Such accommodation shall not be provided in any room or rooms in which any process included in schedule A is carried on, and no washing conveniences mentioned hereafter in rule 13 shall be maintained in any room or rooms provided for such accommodation.

Suitable provision shall be made for the deposit of food brought by the workers.

10. The processes of—

The towing of earthenware,

China scouring,

Ground laying,

Ware cleaning after the dipper,

Color dusting, whether on-glaze or under-glaze,

Color blowing, whether on-glaze or under-glaze,

Glaze blowing, or

Transfer making,

shall not be carried on without the use of exhaust fans, or other efficient means for the effectual removal of dust, to be approved in each particular case by the secretary of state, and under such conditions as he may from time to time prescribe.

In the process of ware cleaning after the dipper, sufficient arrangements shall be made for any glaze scraped off which is not removed by the fan, or the other efficient means, to fall into water.

In the process of ware cleaning of earthenware after the dipper, damp sponges or other damp material shall be provided in addition to the knife or other instrument, and shall be used wherever practicable.

Flat-knocking and fired-flint-sifting shall be carried on only in inclosed receptacles, which shall be connected with an efficient fan or other efficient draft unless so contrived as to prevent effectually the escape of injurious dust.

In all processes the occupier shall, as far as practicable, adopt efficient measures for the removal of dust and for the prevention of any injurious effects arising therefrom.

11. No person shall be employed in the mixing of unfritted lead compounds, in the preparation or manufacture of frits, glazes, or colors containing lead without wearing a suitable and efficient respirator provided and maintained by the employer; unless the mixing is performed in a closed machine or the materials are in such a condition that no dust is produced.

Each respirator shall bear the distinguishing mark of the worker to whom it is supplied.

12. All drying stoves as well as all workshops and all parts of factories shall be effectually ventilated to the reasonable satisfaction of the inspector in charge of the district.

13. The occupier shall provide and continually maintain sufficient and suitable washing conveniences for all persons employed in the processes included in schedule A, as near as practicable to the places in which such persons are employed.

The washing conveniences shall comprise soap, nailbrushes, and towels, and at least one wash (hand) basin for every five persons employed as above, with a constant supply of water laid on, with one tap at least for every two basins,

and conveniences for emptying the same and running off the waste water on the spot down a waste pipe.

There shall be in front of each washing basin, or convenience, a space for standing room which shall not be less in any direction than 21 inches.

14. The occupier shall see that the floors of workshops and of such stoves as are entered by the workpeople are sprinkled and swept daily; that all dust, scraps, ashes, and dirt are removed daily, and that the mangles, workbenches, and stairs leading to workshops are cleansed weekly.

When so required by the inspector in charge of the district, by notice in writing, any such floors, mangles, workbenches, and stairs shall be cleansed in such manner and at such times as may be directed in such notice.

As regards every potters' shop and stove, and every place in which any process included in schedule A is carried on, the occupier shall cause the sufficient cleansing of floors to be done at the time when no other work is being carried on in such room, and in the case of potters' shops, stoves, dipping houses, and majolica painting rooms, by an adult male:

Provided, That in the case of rooms in which ground laying or glost placing is carried on, or in the china dippers' drying room, the cleansing prescribed by this rule may be done before work commences for the day, but in no case shall any work be carried on in the room within one hour after any such cleansing as aforesaid has ceased.

15. The occupier shall cause the boards used in the dipping house, dippers' drying room, or glost-placing shop to be cleansed every week, and shall not allow them to be used in any other department, except after being cleansed.

When so required by the inspector in charge of the district, by notice in writing, any such boards shall be washed at such times as may be directed in such notice.

Duties of persons employed.

16. All women and young persons employed in the processes included in schedule A shall present themselves at the appointed time for examination by the certifying surgeon, as provided in rule 6 as amended.

No person after suspension by the certifying surgeon shall work in any process included in the schedule without a certificate of fitness from the certifying surgeon entered in the register.

17. Every person employed in any process included in schedule A, or in emptying china biscuit ware, shall, when at work, wear a suitable overall and head covering, and also a respirator when so required by rule 11 as amended, which shall not be worn outside the factory or workshop, and which shall not be removed therefrom except for the purpose of being washed or repaired. Such overall and head covering shall be in proper repair and duly washed.

The hair must be so arranged as to be fully protected from dust by the head covering.

The overalls, head coverings, and respirators, when not being worn, and clothing put off during working hours, shall be deposited in the respective places provided by the occupier for such purposes under rule 8 as amended.

18. No person shall remain during meal times in any place in which is carried on any process included in schedule A, or introduce, keep, prepare, or partake of any food or drink, or tobacco therein at any time.

19. No person shall in any way interfere, without the knowledge and concurrence of the occupier or manager, with the means and appliances provided by the employers for the ventilation of the workshops and stoves, and for the removal of dust.

20. No person included in any process included in schedule A shall leave the works or partake of meals without previously and carefully cleaning and washing his or her hands.

No person employed shall remove or damage the washing basins or conveniences provided under rule 13.

20a. The persons appointed by the occupiers shall cleanse the several parts of the factory regularly, as prescribed in rule 14.

Every worker shall so conduct his or her work as to avoid, as far as practicable, making or scattering dust, dirt, or refuse, or causing accumulation of such.

21. The boards used in the dipping house, dippers' drying room, or glost-placing shop shall not be used in any other department, except after being cleansed, as directed in rule 15.

22. If the occupier of a factory to which these rules apply gives with reference to any process included in schedule A, other than china scouring, an

undertaking that no lead or lead compound or other poisonous material shall be used, the chief inspector may approve in writing of the suspension of the operation of rules 4, 5, 6, 7, 8, 15, 16, 17, and 21, or any of them in such process; and thereupon such rules shall be suspended as regards the process named in the chief inspector's approval, and in lieu thereof the following rule shall take effect, viz, no lead or lead compound or other poisonous material shall be used in any process so named.

For the purpose of this rule, materials that contain no more than 1 per cent of lead shall be regarded as free from lead.

SUPPLEMENTARY SPECIAL RULES FOR THE MANUFACTURE OF EARTHENWARE AND CHINA IN FORCE IN CERTAIN WORKS.

23. If the occupier of any factory to which these rules apply gives an undertaking in writing either to the effect that—

(a) No glaze shall be used which yields to a dilute solution of hydrochloric acid more than 5 per cent of its dry weight of a soluble lead compound calculated as lead monoxide when determined in the manner described in rule 2, paragraph 2.

or to the effect that—

(b) No ware shall be cleaned after the application of glaze by dipping or other process except in the moist condition;

The chief inspector of factories may, if satisfied that the other conditions are sufficient for the safety of the persons employed, approve in writing of the suspension in the factory or part of the factory of so much of rule 10 as requires the provision of a fan or other efficient means, to be approved by the secretary of state, for the removal of dust in the process of ware cleaning; and thereupon the said part of rule 10 shall be suspended accordingly, and the said undertaking shall be deemed to be a special rule established in the factory.

24. If the occupier of any factory to which these rules apply gives an undertaking in writing to the effect that no glaze shall be used which yields to a dilute solution of hydrochloric acid more than 2 per cent of its dry weight of a soluble lead compound calculated as lead monoxide when determined in the manner described in rule 2, paragraph 2, the chief inspector of factories may, if satisfied that the other conditions are sufficient for the safety of the persons employed, approve in writing of the modification of rule 5 in so far as it applies to the processes of dipping, drying after dipping, and ware cleaning, in the factory or part of the factory, by the substitution of 14 years for 15 years of age, and thereupon rule 5 shall be modified accordingly, and the said undertaking shall be deemed to be a special rule established in the factory.

Any approval granted under rules 23 and 24 is liable to revocation in case it shall appear to the secretary of state that, owing to the occurrence of lead poisoning in any factory, such revocation is desirable.

25. No ware shall be cleaned after the application of glaze by dipping or other process, except in the moist state, or with damp sponge or other similar damp material, or with the use of an efficient exhaust draft.

So much of rule 10 as requires the provision of a fan or other efficient means for the removal of dust in the process of ware cleaning after the dipper shall not apply.

SCHEDULE A.

Dipping or other process carried on in the dipping house.

Glaze blowing.

Painting in majolica or other glaze.

Drying after dipping.

Ware cleaning after the application of glaze by dipping or other process.

China scouring.

Glost placing.

Ground laying.

Color dusting } whether on-glaze or under-glaze.

Color blowing }

Lithographic transfer making.

Making or mixing of frits, glazes, or colors containing lead.

Any other process in which materials containing lead are used or handled in the dry state, or in the form of spray, or in suspension in liquid other than oil or similar medium.

SCHEDULE B.¹

NOTICE TO WORKMEN EMPLOYED IN PROCESSES NAMED IN SCHEDULE A, OTHER THAN CHINA SCOURING.

Conditions of compensation.

1. Where a workman is suspended from working by a certifying surgeon of the district on the ground that he is of opinion that such person by continued work in lead will incur special danger from the effects of plumbism, and the certifying surgeon shall certify that in his opinion he is suffering from plumbism arising out of his employment, he shall, subject as hereinafter mentioned, be entitled to compensation from his employer as hereinafter provided.

(a) If any workman who has been suspended as aforesaid dies within nine calendar months from the date of such certificate of suspension, by reason of plumbism contracted before the said date, there shall be paid to such of his dependents as are wholly dependent upon his earnings at the time of his death or upon the weekly compensation payable under this scheme, a sum equal to the amount he has earned during a period of three years next preceding the date of the said certificate, such sum not to be more than £300 [\$1,459.95] nor less than £150 [\$729.98] for an adult male, £100 [\$486.65] for an adult female, and £75 [\$364.99] for a young person.

(b) If the workman does not leave any dependents wholly dependent as aforesaid, but leaves any dependents in part dependent as aforesaid, a reasonable part of that sum.

(c) If he leaves no dependents, the reasonable expenses of his medical attendance and burial, not exceeding £10 [\$48.67].

2. With respect to such payments the following provisions shall apply:

(a) All sums paid to the workman as compensation since the date of the said certificate shall be deducted from the sums payable to the dependents.

(b) The payment shall, in case of death, be made to the legal personal representative of the workman, or, if he has no legal personal representative, to or for the benefit of his dependents, or, if he leaves no dependents, to the person to whom the expenses are due; and if made to the legal personal representative shall be paid by him to or for the benefit of the dependents or other person entitled thereto.

(c) Any question as to who is a dependent, or as to the amount payable to each dependent, shall in default of agreement be settled by arbitration as hereinafter provided in clause 9.

(d) The sum allotted as compensation to a dependent may be invested or otherwise applied for the benefit of the person entitled thereto, as agreed, or as ordered by the arbitrator.

(e) Any sum which is agreed or is ordered by the arbitrator to be invested may be invested in whole or in part in the Post-Office Savings Bank.

3. Where a workman has been suspended and certified as provided in condition 1, and while he is totally or partially prevented from earning a living by reason of such suspension, he shall be entitled to a weekly payment not exceeding 50 per cent of his average weekly earnings at the time of such suspension, such payment not to exceed £1 [\$4.87]. The average may be taken over such period, not exceeding 12 months, as appears fair or reasonable, having regard to all the circumstances of the case.

4. In fixing these weekly payments, regard shall be had to the difference between the amount of the average weekly earnings of the workman at the time of his suspension and the average amount, if any, which it is estimated that he will be able to earn afterwards in any occupation or employment, and to any payments (not being wages) which he may have received from the employer in respect to the suspension, and to all the circumstances of the case, including his age and expectation of life.

5. If it shall appear that any workman has persistently disobeyed the special rules or the directions given for his protection by his employers, and that such disobedience has conduced to his suspension, or has not presented himself for examination by the certifying surgeon, or has failed to give full information and assistance as provided in condition 6, his conduct may be taken into consideration in assessing the amount of the weekly payments.

¹ Provision has since been made for compensation in case of lead poisoning by section 8 of the Workmen's Compensation Act, 1906.

6. It shall be the duty of every workman at all times to submit to medical examination when required and to give full information to the certifying surgeon and to assist to the best of his power in the obtaining of all facts necessary to enable his physical condition to be ascertained.

7. Any weekly payment may be reviewed at the request either of the employer or of the workman, and on such review may be ended, diminished, or increased, subject to the maximum above provided, and the amount of payments shall, in default of agreement, be settled by arbitration.

8. Any workman receiving weekly payments under this scheme shall submit himself if required for examination by a duly qualified medical practitioner provided and paid by the employer.

If the workman refuses to submit himself to such examination, or in any way obstructs the same, his right to such weekly payments shall be suspended until such examination has taken place.

9. If any dispute shall arise as to any certificate of the certifying surgeon or as to the amount of compensation payable as herein provided, or otherwise in relation to these provisions, the same shall be decided by an arbitrator to be appointed by the employer and workman, or in default of agreement by the secretary of state. The said arbitrator shall have all the powers of an arbitrator under the arbitration act and his decision shall be final.

The fee of the arbitrator shall be fixed by the secretary of state, and shall be paid as the arbitrator shall direct.

10. No compensation shall be payable under these provisions unless a claim in writing is made within six weeks of the date of the certificate of suspension, or of the death: *Provided*, That the want of such notice shall not bar the claim if in the opinion of the arbitrator there was reasonable excuse for the want of it.

A claim for compensation by any workman whose employment is intermittent, or casual, or who is regularly employed by more than one employer, shall only arise against the employers for whom he has worked in a process included in schedule A within one month prior to his suspension. The said employers shall bear the compensation among them in such proportion as in default or agreement shall be determined by an arbitrator as herein provided.

11. "Employer" includes an occupier, a corporation, and the legal representatives of a deceased employer. "Workman" includes every person, male or female, whether his agreement be one of service or apprenticeship or otherwise, and is expressed or implied, orally or in writing, and shall include the personal representatives of a deceased workman. "Dependents" has the same meaning as in the Workmen's Compensation Act, 1897.¹

The terms contained in this notice shall be deemed to be part of the contract of employment of all workmen in the above-named processes.

(Occupier's signature.) _____

FOR THE MANUFACTURE OF TRANSFERS FOR EARTHENWARE AND CHINA.

Duties of occupiers.

1. No person under 15 years of age shall be employed in making transfers for earthenware or china.

2. All women and young persons employed shall be examined once a month by the certifying surgeon for the district, who shall after May 1, 1899, have power to order suspension from employment.

No person after such suspension shall be allowed to work without the written sanction of the certifying surgeon.

3. A register, in the form which has been prescribed by the secretary of state for use in earthenware and china works, shall be kept, and in it the certifying surgeon will enter the dates and results of his visits, the number of persons examined, and particulars of any directions given by him. This register shall contain a list of all persons employed, and shall be produced at any time when required by His Majesty's inspector of factories or by the certifying surgeon.

4. The occupier shall provide and maintain suitable overalls and head coverings for all women and young persons employed in rooms in which color processes are carried on.

All overalls and head coverings shall be kept by the occupier in proper custody and shall be washed at least once a week, and suitable arrangements shall be made for carrying out these requirements.

A suitable place shall be provided in which the above workers can deposit clothing put off during working hours.

It shall be a sufficient compliance with the requirements of this rule as to head coverings if they are made of suitable glazed paper and renewed once a week. The head coverings shall be made so as completely to cover the hair and to the satisfaction of the inspector.

5. No person shall be allowed to prepare or partake of any food or drink, or to remain during mealtimes, in any place in which is carried on the making of transfers.

The occupier shall make suitable provision to the reasonable satisfaction of the inspector in charge of the district for the accommodation during mealtimes of persons employed in such places or processes, with a right of appeal to the chief inspector of factories.

6. Transfer making shall not be carried on without the use of exhaust fans for the effectual removal of dust, or other efficient means for the effectual removal of dust, to be approved in each particular case by the secretary of state, and under such conditions as he may from time to time prescribe.

7. The occupier shall provide and maintain sufficient and suitable washing conveniences for all persons employed, as near as is practicable to the places in which such persons are employed.

The washing conveniences shall comprise soap, nailbrushes, and towels, and at least one wash hand basin for every five persons employed as above, with a constant supply of water laid on, with one tap at least for every two basins, and conveniences for emptying the same and running off the waste water on the spot down a waste pipe.

Duties of persons employed.

8. All women and young persons employed shall present themselves at the appointed time for examination by the certifying surgeon as provided in rule 2. No person after suspension by the certifying surgeon shall work without the written sanction of the certifying surgeon.

9. Every person employed in any room in which color processes are carried on shall, when at work, wear an overall suit and head covering, which shall not be worn outside the factory or workshop, and which shall not be removed therefrom except for the purpose of being washed. All overalls and head coverings shall be washed or renewed at least once a week.

The overalls and head coverings, when not being worn, shall be deposited in the place provided for the purpose under rule 4.

Clothing put off during working hours shall be deposited in the place provided for the purpose under rule 4.

It shall be a sufficient compliance with the requirements of this rule as to head coverings if they are made of suitable glazed paper and renewed once a week. The head coverings shall be made so as completely to cover the hair and to the satisfaction of the inspector.

10. No person shall remain during mealtimes in any place in which is carried on the making of transfers; or prepare or partake of any food or drink therein at any time.

11. No person shall in any way interfere, without the knowledge and concurrence of the occupier or manager, with the means and appliances provided by the employers for the ventilation of the workshops and for the removal of dust.

12. No person employed shall leave the works or partake of meals without previously and carefully cleaning and washing his or her hands.

REGULATIONS FOR VITREOUS ENAMELING OF METAL OR GLASS.¹

Whereas the process of vitreous enameling of metal or glass has been certified in pursuance of section 79 of the Factory and Workshop Act, 1901,² to be dangerous;

* * * The following regulations * * * shall apply to all factories and workshops in which vitreous enameling of metal or glass is carried on.

Provided that nothing in these regulations shall apply to—

- (a) the enameling of jewelry or watches; or
- (b) the manufacture of stained glass; or
- (c) enameling by means of glazes or colors containing less than 1 per cent of lead.

These regulations shall come into force on 1st April, 1909.

¹ These regulations were gazetted December 22, 1908.

² 1 Edw. 7, c. 22.

DEFINITIONS.

In these regulations—

“Enameling” means crushing, grinding, sieving, dusting or laying on, brushing or wooling off, spraying, or any other process for the purpose of vitreous covering and decoration of metal or glass;

“Employed” means employed in enameling;

“Surgeon” means the certifying factory surgeon of the district or a duly qualified medical practitioner appointed by written certificate of the chief inspector of factories, which appointment shall be subject to such conditions as may be specified in that certificate;

“Suspension” means suspension by written certificate in the health register, signed by the surgeon, from employment in any enameling process.

DUTIES.

It shall be the duty of the occupier to observe Part I of these regulations.

It shall be the duty of all persons employed to observe Part II of these regulations.

Part I.—Duties of employers.

1. Every room in which any enameling process is carried on—
 - (a) shall contain at least 500 cubic feet of air space for each person employed therein, and in computing this air space no height above 14 feet shall be taken into account;
 - (b) shall be efficiently lighted, and shall for this purpose have efficient means of lighting both natural and artificial.
2. In every room in which any enameling process is carried on—
 - (a) the floors shall be well and closely laid, and be maintained in good condition;
 - (b) the floors and benches shall be cleansed daily and kept free of collections of dust.
3. No enameling process giving rise to dust or spray shall be done save either—
 - (a) under conditions which secure the absence of dust and spray; or
 - (b) with an efficient exhaust so arranged as to intercept the dust or spray and prevent it from diffusing into the air of the room.
4. Except in cases where glaze is applied to a heated metallic surface, dusting or laying on, and brushing or wooling off, shall not be done except over a grid with a receptacle beneath to intercept the dust falling through.
5. If firing is done in a room not specially set apart for the purpose, no person shall be employed in any other process within 20 feet from the furnace.
6. Such arrangements shall be made as shall effectually prevent gases generated in the muffle furnaces from entering the workrooms.
7. No child or young person under 16 years of age shall be employed in any enameling process.
8. A health register, containing the names of all persons employed, shall be kept in a form approved by the chief inspector of factories.
9. Every person employed shall be examined by the surgeon once in every three months (or at such intervals as may be prescribed in writing by the chief inspector of factories) on a date of which due notice shall be given to all concerned.
10. The surgeon shall have power of suspension as regards all persons employed, and no person after suspension shall be employed without written sanction from the surgeon entered in the health register.
11. There shall be provided and maintained for the use of all persons employed—
 - (a) suitable overalls and head coverings, which shall be collected at the end of every day's work, and be cleaned or renewed at least once every week;
 - (b) a suitable place, separate from the cloakroom and meal room, for the storage of the overalls and head coverings;
 - (c) a suitable cloakroom for clothing put off during working hours;
 - (d) a suitable meal room separate from any room in which enameling processes are carried on, unless the works are closed during meal hours.

12. There shall be provided and maintained in a cleanly state and in good repair, for the use of all persons employed, a lavatory, under cover, with a sufficient supply of clean towels, renewed daily, and of soap and nailbrushes, and with either—
- (a) a trough with a smooth impervious surface, fitted with a waste pipe without a plug, and of such length as to allow at least two feet for every five such persons, and having a constant supply of warm water from taps or jets above the trough at intervals of not more than two feet; or
 - (b) at least one lavatory basin for every five such persons, fitted with a waste pipe and plug or placed in a trough having a waste pipe, and having either a constant supply of hot and cold water or warm water laid on, or (if a constant supply of heated water be not reasonably practicable) a constant supply of cold water laid on and a supply of hot water always at hand when required for use by persons employed.
13. The occupier shall allow any of H. M. inspectors of factories to take at any time sufficient samples for analysis of any enameling material in use or mixed for use.

Provided, that the occupier may at the time when the sample is taken, and upon providing the necessary appliances, require the inspector to take, seal and deliver to him a duplicate sample.

No results of any analysis shall be published without the consent of the occupier, except such as may be necessary to prove the presence of lead when there has been infraction of the regulations.

Part II.—Duties of persons employed.

14. Every person employed shall—
- (a) present himself at the appointed time for examination by the surgeon as provided in regulation 9;
 - (b) wear the overall and head covering provided under regulation 11 (a), and deposit them and clothing put off during working hours, in the places provided under regulation 11 (b) and (c);
 - (c) carefully clean the hands before partaking of any food or leaving the premises;
 - (d) so arrange the hair that it shall be effectually protected from dust by the head covering.
15. No person employed shall—
- (a) after suspension, work in any enameling process without written sanction from the surgeon entered in the health register;
 - (b) introduce, keep, prepare, or partake of any food, drink, or tobacco, in any room in which an enameling process is carried on;
 - (c) interfere in any way, without the concurrence of the occupier or manager, with the means and appliances provided for the removal of dust or fumes, and for the carrying out of these regulations.

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